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Radiological Health Data

VOLUME II, NUMBER 6
JUNE 1961

Monthly Report

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

Radiological Health Data is published by the Public Health Service on a monthly basis. Data are provided to the Division of Radiological Health by other Federal agencies, State health departments, and foreign governments. Except where material is directly quoted or otherwise credited, summaries and abstracts are prepared by the staff of the Data Collation and Analysis Unit, Division of Radiological Health. The reports are reviewed by a Board of Editorial Advisers with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
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RADIOLOGICAL HEALTH DATA

MONTHLY REPORT JUNE 1961

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service • Division of Radiological Health

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CORRECTION FOR THE MAY ISSUE—SECTION I.—AIR

Technical difficulties during the programing of radon and thoron measurements for electronic data processing resulted in the publication of incorrect figures on table 2 on page 209 of last month's report, *Radiological Health Data*, volume II, No. 5. The table below presents the revised data.

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of environmental radioactivity due to fallout from nuclear weapons tests Although no nuclear tests have been conducted by the United States since 1958, the program has proved sufficiently valuable that it has been extended to a year-round basis. Currently, it consists of 46 stations at urban locations (see fig. 1) operated by State and local health department personnel with 2 stations operated by Public Health Service personnel.

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

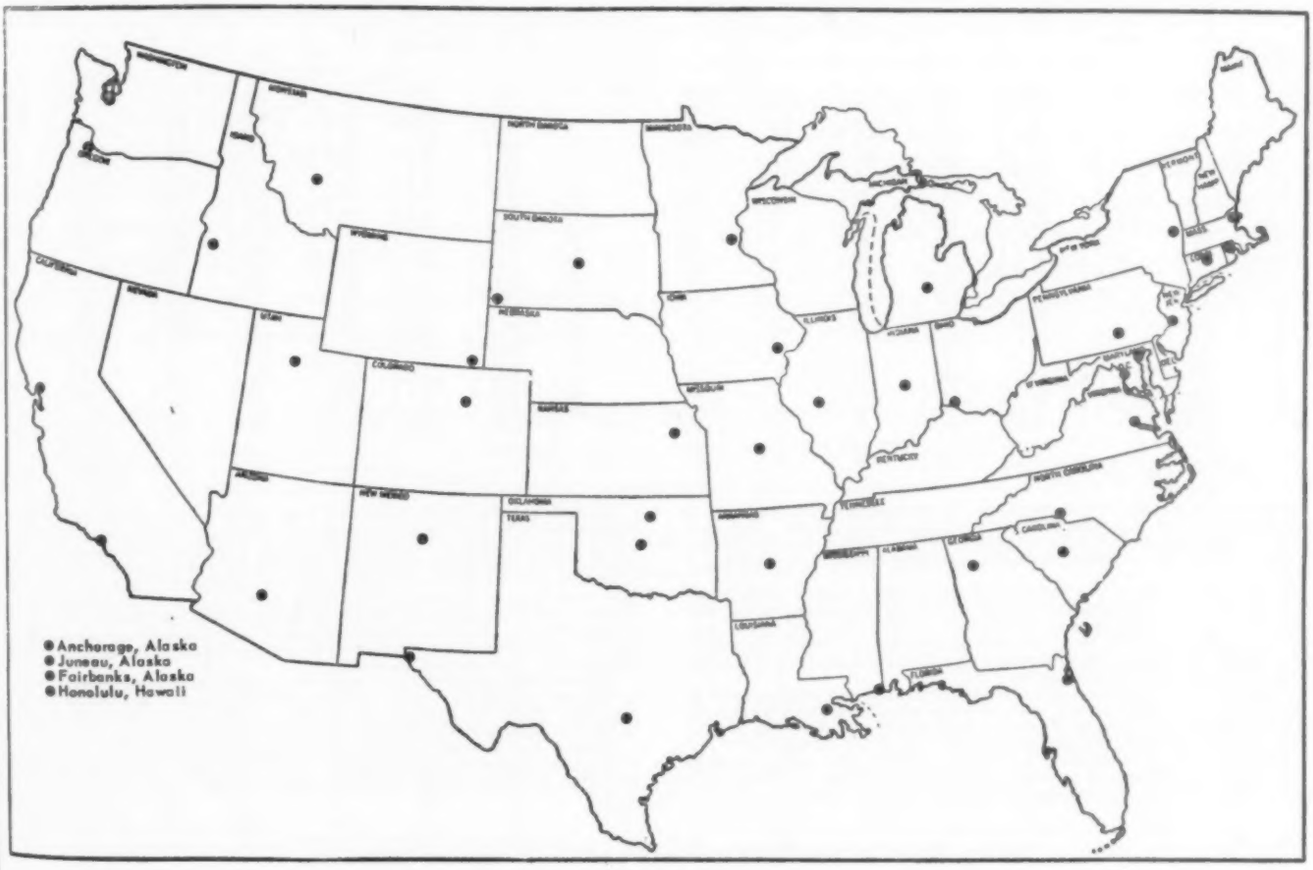


TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR—GROSS BETA DETERMINATIONS

Public Health Service Radiation Surveillance Network, January 1961

Station location	Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Weighted average ($\mu\mu c/m^3$)	Station location	Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Weighted average ($\mu\mu c/m^3$)
Anchorage, Alaska	21	<0.10	<0.10	<0.10	Pascagoula, Miss	20	0.21	<0.10	<0.12
Fairbanks, Alaska	21	.16	<.10	<.11	Jefferson City, Mo	21	.12	<.10	<.10
Juneau, Alaska	22	.11	<.10	<.10	Helena, Mont	21	.11	<.10	<.10
Phoenix, Ariz	6	.22	<.10	<.13	Trenton, N.J	0			
Little Rock, Ark	21	.12	<.10	<.10	Santa Fe, N. Mex	21	.16	<.10	<.12
Berkeley, Calif	20	.15	<.10	<.11	Albany, N.Y	31	<.10	<.10	<.10
Los Angeles, Calif	21	.24	<.10	<.13	Gastonia, N.C	18	.15	<.10	<.10
Denver, Colo	16	.16	<.10	<.11	Cincinnati, Ohio	21	.20	.00	.07
Hartford, Conn	28	.10	<.10	<.10	Oklahoma City, Okla	20	.13	<.10	<.10
District of Columbia	20	.12	<.10	<.10	Ponca City, Okla	31	.13	<.10	<.10
Jacksonville, Fla	17	.17	<.10	<.10	Portland, Oreg	21	.23	<.10	<.12
Atlanta, Ga	17	.21	.03	.06	Harrisburg, Pa	14	<.10	<.10	<.10
Honolulu, Hawaii	21	<.10	<.10	<.10	Providence, R.I	20	<.10	<.10	<.10
Boise, Idaho	16	.44	<.10	<.18	Columbia, S.C	5	<.10	<.10	<.10
Springfield, Ill	9	<.10	<.10	<.10	Pierre, S. Dak	7	.11	<.10	<.10
Indianapolis, Ind	29	<.10	<.10	<.10	Austin, Tex	20	.12	<.10	<.10
Iowa City, Iowa	21	.11	<.10	<.10	El Paso, Tex	19	.36	<.10	<.16
Topeka, Kans	22	.12	<.10	<.10	Salt Lake City, Utah	31	.21	<.10	<.12
New Orleans, La	6	<.10	<.10	<.10	Richmond, Va	20	.12	<.10	<.10
Baltimore, Md	19	<.10	<.10	<.10	Seattle, Wash	19	.11	<.10	<.10
Lawrence, Mass	21	<.10	<.10	<.10	Madison, Wis	22	<.10	<.10	<.10
Lansing, Mich	30	<.10	<.10	<.10	Cheyenne, Wyo	9	<.10	<.10	<.10
Minneapolis, Minn	8	<.10	<.10	<.10					

TABLE 2.—RADON AND THORON MEASUREMENTS

Radiation Surveillance Network, Public Health Service, Station at Cincinnati, Ohio, Dec. 2, 1960–Jan. 3, 1961

Date	Continuous sample collection			Radon [a] a.m. ($\mu\mu c/m^3$)	Radon-thoron [b] p.m. ($\mu\mu c/m^3$)	Thoron [c] ($\mu\mu c/m^3$)	Beta [d] activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
Dec. 2	0822	24.1	27.5	320	---------	2.3	0.03
5	0822	72.0	84.0	390	80	4.9	.07
6	0815	23.9	29.1	250	120	2.4	.19
7	0835	24.3	28.6	300	160	1.7	.14
8	0821	23.7	27.3	360	160	2.1	.14
9	0814	23.9	28.2	300	160	1.4	.07
12	0842	72.5	86.8	110	90	1.5	.05
13	0835	23.9	29.2	210	40	.6	.08
14	0823	23.8	28.8	190	60	.8	.05
15	0827	24.0	29.2	160	140	.9	.05
16	0820	23.9	29.1	110	150	.9	.07
19	0828	72.1	85.9	210	130	1.3	.06
20	0823	23.9	28.6	240	100	.4	.02
21	0825	24.0	28.5	120	300	.6	.00
22	0823	24.0	28.9	240	150	.6	.13
23	0838	24.2	30.1	250	130	.7	.00
27	0808	95.5	113.8	40	170	.5	.03
28	0807	24.0	29.3	220	30	.4	.03
29	0812	24.1	28.9	430	190	.6	.04
30	0812	24.0	29.0	170	210	.8	.12
Jan. 3	0810	96.0	113.9	190	160	.5	.04
Av	---------		---------	230	136	1.2	.07

[a] Radon concentrations are derived from alpha measurements determined immediately after the sampling period (24 to 72 hours) has ceased. Reported radon concentrations have been corrected for any thoron daughter interferences. Twice the standard deviation (2σ) falls between ± 18 and ± 37 $\mu\mu c/m^3$.

[b] Radon concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. Therefore, the reported values were actually determined one day prior to the date reported here. Reported radon concentrations are uncorrected for any thoron daughter interferences. Twice the standard deviation (2σ) falls between ± 9 and ± 25 $\mu\mu c/m^3$.

[c] Thoron concentrations are derived from alpha measurements referred to in footnote (a) but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter holder. Twice the standard deviation (2σ) falls between ± 0.2 and ± 0.7 $\mu\mu c/m^3$.

[d] Gross beta concentrations are based on measurements made at least 4 days after the end of each sampling period (24 to 72 hours). Twice the standard deviation (2σ) fallbe stween ± 0.02 and ± 0.10 $\mu\mu c/m^3$.

Radiation Surveillance Network, Public Health Service, Station at Cincinnati, Ohio, Jan. 4–Feb. 1, 1961

Date	Continuous sample collection			Radon [a] a.m. ($\mu\mu c/m^3$)	Radon-thoron [b] p.m. ($\mu\mu c/m^3$)	Thoron [c] ($\mu\mu c/m^3$)	Beta [d] activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
Jan. 4	0810	24.0	28.8	350	120	0.9	0.12
5	0826	24.2	29.0	470	310	1.1	.20
6	0816	23.8	28.7	140	170	.7	.03
9	0822	72.1	86.7	110	160	.5	.07
10	0815	23.9	28.8	580	80	2.2	.11
11	0808	23.9	28.9	440	110	2.0	.04
12	0817	24.1	28.8	790	180	3.5	.13
13	0828	24.2	28.5	800	290	3.7	.07
16	0825	71.9	86.1	170	260	1.0	.08
17	0817	23.9	28.5	120	240	.9	.13
18	0815	23.9	27.9	340	120	1.5	.05
19	0824	24.1	28.1	200	140	1.5	.13
20	0817	23.9	28.8	150	160	.9	.00
23	0827	72.1	84.7	200	160	.9	.04
24	0812	23.7	28.0	220	120	.5	.01
25	0820	24.1	29.6	240	70	.6	.00
26	0816	23.9	28.4	150	50	.4	.14
27	0833	24.3	29.2	180	180	.4	.06
30	0816	71.7	83.6	220	160	.8	.07
31	0815	24.0	28.5	440	90	.9	.03
Feb. 1	0802	23.8	28.0	760	210	1.6	.08
Av	---------		---------	347	161	1.26	.08

[a] Radon concentrations are derived from alpha measurements determined immediately after the sampling period (24 to 72 hours) has ceased. Reported radon concentrations have been corrected for any thoron daughter interferences. Twice the standard deviation (2σ) falls between ± 19 and ± 49 $\mu\mu c/m^3$.

[b] Radon concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. Therefore, the reported values were actually determined 1 day prior to the date reported here. Reported radon concentrations are uncorrected for any thoron daughter interferences. Twice the standard deviation (2σ) falls between ± 16 and ± 37 $\mu\mu c/m^3$.

[c] Thoron concentrations are derived from alpha measurements referred to in footnote (a) but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter holder. Twice the standard deviation (2σ) falls between ± 0.20 and ± 0.62 $\mu\mu c/m^3$.

[d] Gross beta concentrations are based on measurements made at least 4 days after the end of each sampling period (24 to 72 hours). Twice the standard deviation (2σ) falls between ± 0.02 and ± 0.10 $\mu\mu c/m^3$.

NOTE: Refer to page ii for correction of the December 1960 data.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. Field measurements enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known source using a portable survey meter. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D.C., for a more refined measurement using a thin window proportional counter. The stations located at Atlanta, Ga., and Cincinnati, Ohio, conduct their own laboratory analyses.

Air samplers are in operation at the 46 stations on an average of 70 percent of the week. Air is drawn through a cellulose carbon-loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples. About 85 percent of the stations collect samples of precipitation which are sent to Washington, D.C., for analysis. Values are now below limits of detection by present instrumentation.

Tables 1 and 2 summarize the data for January 1961.

Radioactivity Measurements In Air

U.S. Naval Research Laboratory

Radioactivity measurements of air-filter samples collected at various sites near the 80th meridian (west) are made by the U.S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during January 1961 is presented in table 1, and the radioactivity profile for the same month is shown in figure 1. Radioactive debris from the French nuclear test of December 27, 1960, was detected on two filters exposed at Miraflores, Panama (collections of January 6–9 and 9–11, 1961) and on a single filter exposed at San Juan, P.R. (collection of January 6–9, 1961). None was detected at any of the other collection sites. The presence of fresh fission products on the above filters was confirmed by measurement of the rate of decay of the gross beta activity.

Figure 1 now illustrates the data plotted in semilogarithmic coordinates. Previously the data were presented in rectangular coordinates with the abscissa expressed in disintegrations per minute per cubic meter. The concentrations in table 1 are expressed in disintegrations per minute per cubic meter of air at the collecting site (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

TABLE 1.—DAILY RECORD OF FISSION PRODUCT BETA ACTIVITY COLLECTED BY AIR FILTRATION

U.S. Naval Research Laboratory, January 1961

[dpm/m³]

Day	Punta Arenas, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal	San Juan, P.R.	Mauno Loa, Hawaii	Miami, Fla.	Washington, D.C.	Moosonee, Ontario, Canada	Thule, Greenland
1	0.03	0.15	0.13	0.01	0.08	0.06	0.14	----------	0.03	0.08	0.11	0.07	0.13
2	.03	.15	.13	.01	.08	.05	.14	0.14	.03	.08	.11	.07	.13
3	.04	.09	.06	.01	.13	.07	.14	.14	.10	.14	.16	.08	.34
4	.04	.09	.06	.08	.13	.08	.14	.14	.10	.14	.16	.08	.34
5	.03	.09	.10	.06	.04	.07	.09	.11	.12	.16	.18	.11	.10
6	.03	.09	.10	----------	.04	.08	.09	.11	.12	.16	.18	.11	.10
7	.01	.08	.10	.01	.03	.06	3.38	1.59	.08	.16	.12	.11	.10
8	.01	.08	.10	.01	.03	.05	3.38	1.59	.08	.16	.12	.11	.10
9	.01	.08	.10	.03	.03	.04	3.38	1.59	.08	.16	.12	.11	.10
10	.01	.12	.09	.04	.03	----------	2.91	.14	.09	.20	.10	.11	.09
11	.01	.12	.09	.04	.03	.10	2.91	.14	.09	.20	.10	.11	.09
12	.004	.10	.10	.03	.02	----------	.15	.06	.12	.11	.14	.10	.09
13	.004	.10	.10	.06	.02	.10	.15	.06	.12	.11	.14	.10	.09

TABLE 1.—DAILY RECORD OF FISSION PRODUCT BETA ACTIVITY COLLECTED BY AIR FILTRATION—Con.

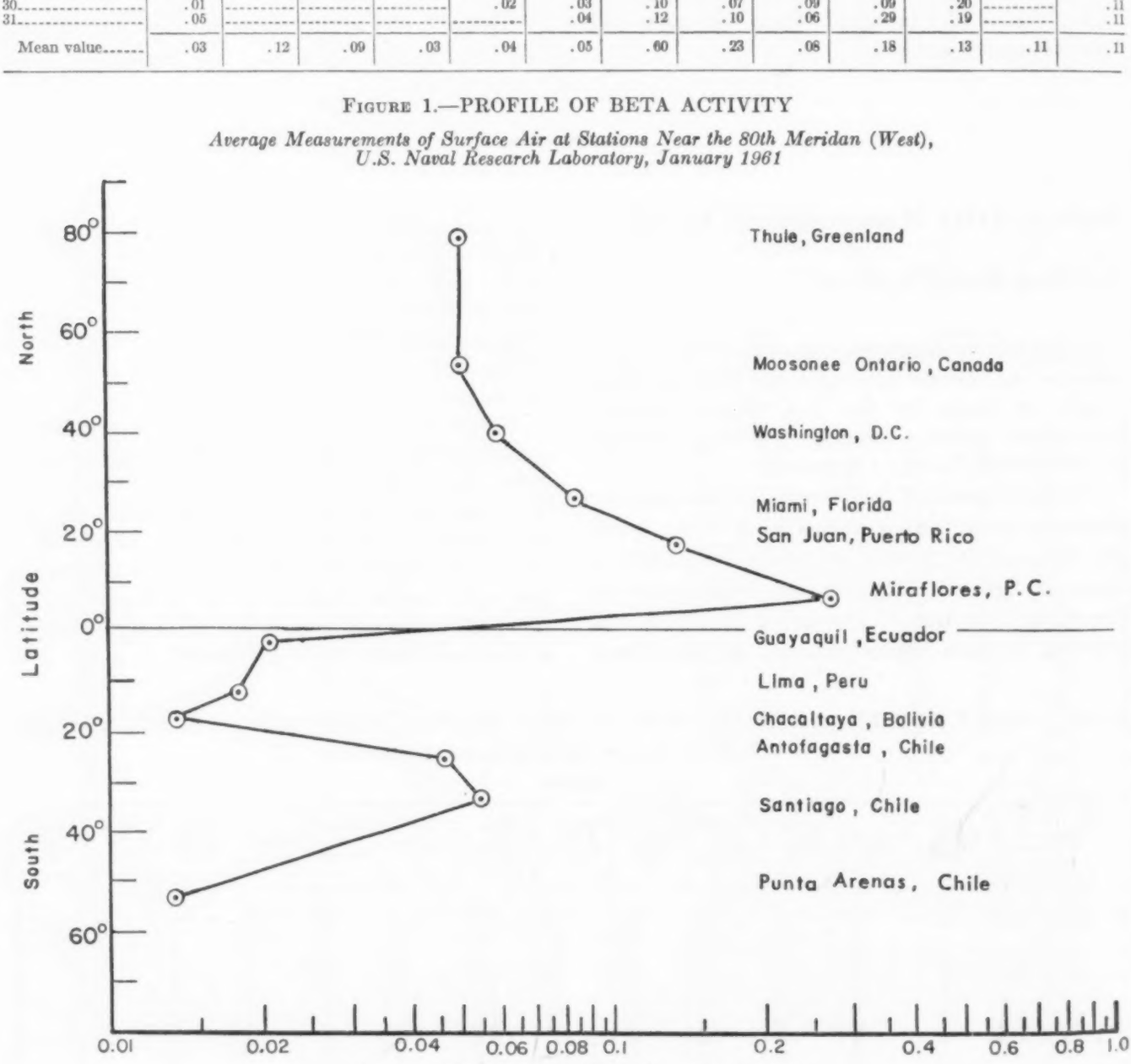
U.S. Naval Research Laboratory, January 1961—Continued

[dpm/m³]

Day	Punta Arenas, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal	San Juan, P.R.	Mauno Loa, Hawaii	Miami, Fla.	Washington, D.C.	Moosonee, Ontario, Canada	Thule, Greenland
14	0.05	0.08	0.11	0.06	0.08	0.10	0.12	0.06	0.08	0.11	0.13	0.12	0.07
15	.05	.08	.11	.05	.06	.10	.12	.06	.08	.11	.13	.12	.07
16	.05	.08	.11	.04	.06	.06	.12	.06	.08	.11	.13	.12	.07
17	.04	.15	.06	.04	.02	.07	.10	.06	.09	----------	.08	.17	.07
18	.04	.15	.06	.03	.02	.07	.10	.06	.09	----------	.08	.17	.07
19	.01	.14	.07	.05	.04	.06	.04	.06	.04	.42	.10	.28	.05
20	.01	.14	.07	.02	.04	.05	.04	.06	.04	.42	.10	----------	.05
21	.02	.13	.06	.02	.01	.03	.05	.06	.03	.19	.10	.09	.05
22	.02	.13	.06	.05	.01	.03	.05	.06	.03	.19	.10	.09	.06
23	.02	.13	.06	.04	.01	.04	.05	.06	.03	.19	.10	.09	.06
24	.07	.15	.12	.05	.02	.04	.07	.09	.08	.31	.13	----------	.06
25	.07	.15	.12	.01	.02	.01	.07	.09	.08	.31	.13	----------	.18
26	.09	.13	.13	.01	.04	.01	.07	.06	.06	.17	.11	----------	.18
27	.09	.13	.13	.01	.04	.01	.07	.06	.06	.17	.11	----------	.17
28	.01	----------	----------	----------	.02	.03	.10	.07	.09	.09	.20	----------	.17
29	.01	----------	----------	----------	.02	.03	.10	.07	.09	.09	.20	----------	.11
30	.01	----------	----------	----------	.02	.03	.10	.07	.09	.09	.20	----------	.11
31	.05	----------	----------	----------	----------	.04	.12	.10	.06	.29	.19	----------	.11
Mean value	.03	.12	.09	.03	.04	.05	.60	.23	.08	.18	.13	.11	.11

FIGURE 1.—PROFILE OF BETA ACTIVITY

Average Measurements of Surface Air at Stations Near the 80th Meridan (West), U.S. Naval Research Laboratory, January 1961



Atmospheric Levels of Fission Product Gross Beta Activity Collected in Italy

Division of Biology and Sanitary Protection, Italian National Committee for Nuclear Energy

The following tables present the results of atmospheric gross beta measurements made at ground level throughout Italy during the third and fourth quarters of 1959, and the first and second quarters of 1960.

These tables were compiled from data which appeared in report number BIO/03/60 entitled, "Data on Environmental Radioactivity, Collected in Italy (July–December 1959)," and report number BIO/24/60 entitled, "Data on Environmental Radioactivity, Collected in Italy (January–June 1960)." These reports were issued in March and September 1960, respectively, by the National Committee for Nuclear Energy.

Figure 1 shows the approximate geographic locations of the sampling stations referred to in tables 1 and 2.

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN AIR AT GROUND LEVEL, 1959

[Average concentration in $\mu\mu c/m^3$]

Station	3d quarter	4th quarter
Bari	0.55	0.08
Bologna	.64	.09
Casaccia	(1)	.14
Elmas	.73	.09
Ferrania	1.02	.11
Genova	.59	.08
Ispra	.54	.11
Latina	[3].56	.24
Livorno	.57	.16
Messina	.70	.11
Milano "A"	.77	.10
Milano "B"	[2]1.39	.19
Milano "C"	.67	.12
Monte Cimone	.57	.11
Napoli "A"	.65	.10
Napoli "B"	.92	.14
Padova	[3].43	.04
Palermo	.61	.08
Pian Rosà	.63	.11
Resina	.59	.08
S. Donato Milanese	.05	.09
S. Giusto	.52	.17
S. Piero a Grado	.62	.28
Trieste	.64	.09
Verbania Pallanza	.63	.09
Vigna Di Valle	.56	.09

[1] No data reported.
[2] Mean is based on measurements made in September.
[3] Mean is based on measurements made in July and September.

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN AIR AT GROUND LEVEL, 1960

[Average concentrations in $\mu\mu c/m^3$]

Station	1st quarter	2d quarter
Alghero	0.09	0.15
Bari	.08	.14
Bologna	.07	.12
Brindisi	[1].10	.13

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN AIR AT GROUND LEVEL, 1960—Continued

[Average concentrations in $\mu\mu c/m^3$]

Station	1st quarter	2d quarter
Casaccia	0.11	0.17
Cozzo Spadaro	[1].13	.16
Elmas	.40	.14
Ferrania	.04	.05
Garigliano Foce	[1].14	.29
Genova	.07	.12
Ispra	.12	.12
Latina	1.67	1.73
Livorno	.07	.07
Messina	.10	.17
Milano "A"	.04	.10
Milano "B"	.09	.12
Milano "C"	.07	.16
Monte Cimone	.12	.15
Monte S. Angelo	.08	.12
Monte Scuro	.12	.21
Monte Terminillo	.08	.16
Napoli "A"	.08	.14
Napoli "B"	.11	.18
Padova	.05	.12
Palermo	.10	.13
Pian Rosà	.36	.20
Resina	.08	.15
Roma (Capannelle)	[1].05	.10
Saluggia	[1].08	.15
S. Donato Milanese	.06	.07
S. Giusto	.07	.08
S. Piero a Grado	.10	.09
Trapani (Chinisia)	.09	.16
Trieste	.07	.11
Verbania Pallanza	.10	.11
Vigna Di Valle	.09	.14

[1] Mean is based on measurements made in February and March.

FIGURE 1.—SAMPLING STATIONS FOR THE DETERMINATION OF FISSION PRODUCT BETA RADIOACTIVITY IN AIR AT GROUND LEVEL—ITALY

SECTION II.—FOOD, OTHER THAN MILK

Tri-City Diet Study

Health and Safety Laboratory, U.S. Atomic Energy Commission

The Health and Safety Laboratory is continuing its dietary survey of the strontium-90 and stable calcium levels of individuals living in New York City, San Francisco, and Chicago. The first complete set of results obtained for these cities was reported in HASL–90 [1] and presented in *Radiological Health Data*, volume II, No. 4.

Selected foods, representing 19 food catagories, are purchased at each of these 3 cities about every 3 months and are analyzed for strontium-90 and stable calcium. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium-90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document.

Tables 1, 2, and 3 present the results obtained from these three cities in the second set of analyses.[2] Some tentative conclusions which may be drawn from the data accumulated to date are:

(*a*) West Coast diets contain less Sr^{90} than East Coast diets,

(*b*) The Sr^{90}/Ca ratio of milk continues to be a good indicator of the ratio for the total diet, although this may not prove to be so at a later time, and

(*c*) The average annual intake of calcium is relatively constant at about 390 grams per year.

[1] *Quarterly Summary Report*, HASL–90, August 18, 1960.

[2] Data from *Quarterly Summary Report*, HASL–111, April 1, 1961.

TABLE 1.—STRONTIUM-90 AND CALCIUM LEVELS OF DIET

New York City, June 1960

Food type	Annual consumption (kg/yr)	Calcium		Strontium-90			Food type	Annual consumption (kg/yr)	Calcium		Strontium-90		
		gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year			gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year
Whole grain products	11	0.98	10.8	28.2	28.8	310	Fruit juices	19	0.09	1.7	3.0	32.8	57
Refined grain products	37	1.30	48.1	10.2	7.8	377	Fruit—fresh	68	.21	14.3	1.9	9.1	129
Refined grain flour	43	.18	7.7	9.2	51.3	397	Rice	3	.38	1.1	1.0	2.8	3
Milk—liquid	221	1.09	240.9	11.0	10.1	2,431	Eggs	16	.58	9.3	2.0	3.5	32
Potatoes	45	.16	7.2	3.2	20.2	144	Fish—fresh	8	1.10	8.8	.3	.3	2
Macaroni	3	.18	.5	4.6	25.6	14	Fish—shell	1	.75	.8	.5	.7	1
Beans—dried	3	.68	2.0	2.2	3.2	7	Meat	73	.09	6.6	.9	10.5	66
Vegetables—canned	20	.23	4.6	2.9	12.5	58	Poultry	17	.15	2.6	.7	4.4	12
Vegetables—fresh	43	.32	13.8	13.6	42.6	585							
Vegetables—root	17	.32	5.4	5.2	16.3	88	Total			388			4,760
Fruit—canned	26	.05	1.3	1.8	36.4	47							

Averages: 12.3 μμc Sr^{90}/gm Ca; 13.0 μμc Sr^{90}/day.

TABLE 2.—STRONTIUM-90 AND CALCIUM-LEVELS OF DIET

San Francisco, August 1960

Food type	Annual consumption (kg/yr)	Calcium		Strontium-90			Food type	Annual consumption (kg/yr)	Calcium		Strontium-90		
		gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year			gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year
Whole grain products	11	0.99	10.9	5.2	5.2	57	Fruit Juices	19	0.11	2.1	2.0	18.3	38
Refined grain products	37	1.00	37.0	4.5	4.5	167	Fruit—fresh	68	.27	18.4	1.0	3.6	68
Refined grain flour	43	.19	8.2	4.0	21.5	172	Rice	3	.58	1.7	1.9	3.2	6
Milk—liquid	221	1.08	238.7	1.9	1.8	420	Eggs	16	.61	9.8	2.3	3.7	37
Potatoes	45	.12	5.4	.6	5.3	27	Fish—fresh	8	.64	5.1	.2	.4	2
Macaroni	3	.22	6.6	3.9	17.6	12	Fish—shell	1	.88	.9	.8	1.0	1
Beans—dried	3	.84	2.5	3.6	4.3	11	Meat	73	.42	30.7	.5	1.3	37
Vegetables—canned	20	.23	4.6	.8	3.3	16	Poultry	17	.58	9.9	1.4	2.5	24
Vegetables—fresh	43	.35	15.1	3.0	8.5	129							
Vegetables—root	17	.31	5.3	.7	2.1	12	Total			414			1,285
Fruit—Canned	26	.05	1.0	1.9	36.0	49							

Averages: 3.1 μμc Sr^{90}/gm Ca; 3.5 μμc Sr^{90}/day.

TABLE 3.—STRONTIUM-90 AND CALCIUM LEVELS OF DIET

Chicago, September 1960

Food type	Annual consumption (kg/yr)	Calcium		Strontium-90			Food type	Annual consumption (kg/yr)	Calcium		Strontium-90		
		gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year			gm/kg original material	gm/year	μμc/kg original material	μμc/gm Ca	μμc/year
Whole grain products	11	1.04	11.4	16.4	15.8	180	Fruit juices	19	0.11	2.1	2.0	18.4	38
Refined grain products	37	1.25	46.3	9.1	7.3	337	Fruit—fresh	68	.23	15.6	1.6	6.9	109
Refined grain flour	43	.09	3.9	7.9	87.7	340	Rice	3	.25	.8	1.4	5.8	4
Milk—liquid	221	1.09	240.9	5.6	5.1	1,238	Eggs	16	.47	7.5	1.9	4.1	30
Potatoes	45	.10	4.5	2.8	28.4	126	Fish—fresh	8	1.26	10.1	.1	.1	1
Macaroni	3	.26	.8	7.5	2.9	23	Fish—shell	1	.48	.5	.5	1.1	1
Beans—dried	3	1.16	3.5	7.4	6.3	22	Meat	73	.09	6.6	1.0	11.1	73
Vegetables—canned	20	.23	4.6	5.4	23.6	108	Poultry	17	1.04	17.7	2.5	2.4	43
Vegetables—fresh	43	.34	14.6	5.5	16.3	237							
Vegetables—root	17	.16	2.7	3.4	21.1	58	Total			395			2,991
Fruit—canned	26	.05	1.3	.9	18.1	23							

Averages: 7.6 μμc Sr^{90}/gm Ca; 8.2 μμc Sr^{90}/day.

Strontium-90 Concentration in Bread Purchased in New York City

Health and Safety Laboratory, U.S. Atomic Energy Commission

The following table presents data on strontium-90 concentrations in bread purchased in New York City during August and September 1960. One loaf of each type is purchased daily from a local grocer and the loaves are composited on a monthly basis. Five brands are represented in each month's sample. Previous results were reported in *Radiological Health Data*, volume I, Nos. 7 and 9, and volume II, No. 4.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN BREAD PURCHASED IN NEW YORK CITY

August and September 1960[1]

Month	Calcium (gm/kg of original material)		Strontium-90					
			μμc/kg of original material		μμc/gm Ca		Intake[2] (μμc/day)	
	Whole wheat	White	Whole wheat	White	Whole wheat	White	Whole wheat	White
August	1.14	0.83	21	8	18	10	0.08	0.37
September	.86	1.08	20	10	3	10	.07	.46

[1] Data taken from Quarterly Summary Report, HASL-111, dated Apr. 1, 1961.
[2] Values calculated by staff of Data Collation and Analysis Unit, DRH, PHS, from U.S. Department of Agriculture data on average daily per capita consumption of 3.6 gm/day of wholewheat bread and 46.2 gm/day of white bread. (See *Radiological Health Data*, Vol. I, No. 5.)

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

The original Public Health Service milk monitoring program consisted of 12 sampling stations, of which 9 are still active. Raw milk is spot sampled at these stations. During 1960 a new sampling program of 60 stations was established. Processed milk is sampled at these stations. Since the sampling procedures for the raw milk sampling stations and the processed milk area sampling stations are different, they are described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, continues to conduct the analyses for the original network stations; the Public Health Service Southeastern Radiological Health Laboratory at Montgomery, Ala., and the Southwestern Radiological Health Laboratory at Las Vegas, Nev., provide analytical services for the new program.

The purposes of the two sampling programs are not the same. The original network was established to develop sampling and radiochemical analytical proficiencies under conditions which would remain similar over a period of time in regard to the source of milk. During the operation of this program it became apparent that a broader sampling program, more directly related to the milk consumed by the population, was necessary. The Public Health Service and the Department of Health, Education, and Welfare acted to provide facilities for this change. This resulted in the transition from the program of sampling raw milk, collected from milksheds of limited size, to a sampling program designed to be representative of the processed milk consumed in a given municipality.

In some instances, the newly designated stations are the same as those which were reported originally. The establishment of the new processed milk area sampling stations does not preclude the need for further raw milk sampling from the selected milkshed serving the same city. It is important that both networks be in operation for a sufficient period of time to provide an overlap for the purpose of comparative study.

Because of the different sources of these samples, changes in the method of collecting samples, and the utilization of different laboratory techniques, differences were anticipated in the amounts of radioactivity found in the milk under the two programs. For this reason, an investigation to determine the comparability of the two programs was begun in January 1961. This investigation covers many factors including laboratory methodology and collection methods. Until this study has been completed and additional experience has been gained under the new program, no valid interpretation can be made of any differences of radioactivity in milk samples collected under the two systems.

Publication of the data will normally follow about 4 months after collection of samples because of the time required for shipment, processing, decay product buildup, compilation of the data, and clearance and publication procedures.

Raw Milk Sampling Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Public Health Service to determine trends in our changing environment with respect to measuring the amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing because it is among the most important components of the diet and is available at all seasons of the year and in all climates. A primary objective of the project was to develop effective collection systems and radiochemical analysis procedures which would make them more suitable for larger-scale programs.

The criteria on which the selection of the original sampling stations was based appeared in the discussion sections of all volume I issues of *Radiological Health Data*.

One-gallon raw milk samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center for radionuclide analyses. It is estimated that these samples represent 2,000-gallon lots. The concentration of iodine-131, barium-140, cesium-137 and naturally occurring potassium-40 are all currently being measured by gamma scintillation spectroscopy. Total radiostrontium and strontium-90 are determined following radiochemical separations. The amount of strontium-90 is calculated by measuring the buildup of the strontium-90 daughter decay product, yttrium-90, over a 2-week period. Measurements are made in a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference between this value and strontium-90. Stable calcium is also determined.

April through September 1960 issues of *Radiological Health Data* list references for technical descriptions of the methodology of analyses used.

January 1961 data for the raw milk sampling stations are presented in table 1.

Processed Milk Area Sampling Stations

The monitoring of milk has been expanded to provide additional information on levels of radioactivity in milk consumed by the public. The new stations have been established in cooperation with State and local health and milk sanitation agencies. Each city has been selected to provide adequate coverage with respect to production areas and the consuming population. The emphases on this expanded sampling and radioassay program are—

1. Measuring the radioactivity levels of the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the processing plant, and
2. Providing one sampling point within each State with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving milk production and milkshed area characteristics.

The new network was designed to sample processed milk rather than the raw product. The sampling procedure was developed to provide a sample from 1 day's sales per month in a community which would be as representative of the total supply as could be achieved under practical conditions. Each sample is a composite of those plants supplying not less than 90 percent of a city's milk supply. The contribution from each plant to the total sample is approximately proportional to volume of milk sold.

The samples from the new stations are collected with the assistance of the various State and local health and milk sanitation agencies and are shipped for analyses to either the Southwestern or Southeastern Radiological Health Laboratory. The Southeastern Radiological Health Laboratory processes samples from the 30 States generally east of the Mississippi, and the Southwestern Radiological Health Laboratory processes samples from the Western States. Figure 1 shows the locations of these stations.

At the present time radioassays for Sr^{89}, Sr^{90}, Cs^{137}, Ba^{140} and I^{131} are being performed. To date, the latter two isotopes have been below present limits of detection. Other radionuclides of concern to public health agencies will be included for assay as necessary for more complete monitoring of the milk supply.

January 1961 data from the two laboratories are presented in table 2.

TABLE 1.—RADIOACTIVITY IN MILK—RAW MILK SAMPLING STATIONS

Public Health Service Milk Monitoring Program, Robert A. Taft Sanitary Engineering Center, January 1961

[Average concentrations in μμc/liter]

Area	Calcium (grams/liter)		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	January	Yearly average	January	Yearly average	January	Yearly average	January	Yearly average	January	Yearly average	January	Yearly average
Atlanta, Ga.	1.23	1.13	ND [1]	<10	ND	<5	13	15	ND	<10	25	35
Austin, Tex.	1.22	1.11	ND	<10	ND	<5	4	4	ND	<10	ND	15
Chicago, Ill.	1.16	1.10	ND	<10	ND	<5	4	9	ND	<10	15	30
Cincinnati, Ohio	1.23	1.14	ND	<10	ND	<5	8	10	ND	<10	10	20
New York, N.Y.	1.14	1.10	ND	<10	ND	<5	8	9	ND	<10	15	25
Sacramento, Calif.	1.17	1.13	ND	<10	ND	<5	4	3	ND	<10	ND	10
Salt Lake City, Utah	1.19	1.12	ND	<10	ND	<5	3	6	ND	<10	5	25
Spokane, Wash.	1.23	1.13	ND	<10	ND	<5	5	10	ND	<10	15	35
St. Louis, Mo.	1.29	1.21	ND	<10	ND	<5	13	17	ND	<10	20	30

[1] ND—No detectable activity.

FIGURE 1.—PROCESSED MILK AREA SAMPLING STATIONS

Public Health Service

TABLE 2.—RADIOACTIVITY IN MILK—PROCESSED MILK AREA SAMPLING STATIONS, JANUARY 1961

Milk Monitoring Program, Public Health Service

[Radioactivity concentrations in $\mu\mu c$/liter]

Area	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	January	Average to date [1]	January	Average to date [1]	January	Average to date	January	Average to date
Albuquerque, N. Mex.	1.13	1.10	ND [3]	<5	6	4	ND	<5
Atlanta, Ga.	1.23	1.24	ND	<5	8	9	ND	<5
Austin, Tex.	1.32	1.20	ND	<5	2	2	ND	<5
Baltimore, Md.	1.43	1.21	ND	<5	6	7	10	<5
Boston, Mass.	1.24	1.20	ND	<5	8	11	10	15
Buffalo, N.Y.	1.20	1.18	ND	<5	6	6	ND	<5
Burlington, Vt.	1.20	1.20	ND	<5	6	8	ND	10
Charleston, S.C.	1.38	1.29	ND	<5	7	10	ND	5
Charleston, W. Va.	1.22	1.19	ND	<5	6	9	ND	<5
Charlotte, N.C.	1.28	1.24	ND	<5	10	12	ND	5
Chattanooga, Tenn.	1.34	1.32	ND	<5	10	10	ND	<5
Chicago, Ill.	1.16	1.15	ND	<5	6	6	ND	<5
Cincinnati, Ohio	1.27	1.19	ND	<5	7	8	ND	<5
Cleveland, Ohio	1.24	1.17	ND	<5	7	7	ND	<5
Dallas, Tex.	1.28	1.22	ND	<5	4	6	ND	<5
Denver, Colo.	1.10	1.10	ND	<5	4	6	5	10
Des Moines, Iowa.	1.12	1.05	ND	<5	8	8	ND	15
Detroit, Mich.	1.18	1.17	ND	<5	6	7	ND	<5
Grand Rapids, Mich.	1.22	1.24	ND	<5	7	7	ND	5
Hartford, Conn.	1.16	1.19	ND	<5	6	8	5	10
Helena, Mont.	1.04	1.08	ND	<5	5	6	ND	10
Honolulu, Hawaii.	1.14	1.07	ND	<5	5	5	ND	20
Idaho Falls, Idaho.	1.07	1.07	ND	<5	6	5	5	15
Indianapolis, Ind.	1.25	1.21	ND	<5	7	6	ND	<5
Jackson, Miss.	1.38	1.32	ND	<5	11	12	ND	<5
Kansas City, Mo.	1.14	1.07	ND	<5	7	8	5	10
Laramie, Wyo.	1.08	1.06	ND	<5	3	5	ND	5
Las Vegas, Nev.	1.07	1.04	ND	<5	1	2	ND	<5
Little Rock, Ark.	1.24	1.21	ND	<5	12	13	ND	<5
Louisville, Ky.	1.24	1.20	ND	<5	8	9	ND	<5
Manchester, N.H.	1.19	1.22	ND	<5	9	11	20	25
Memphis, Tenn.	1.32	1.27	ND	<5	7	10	ND	<5
Milwaukee, Wis.	1.20	1.18	ND	<5	6	6	ND	<5
Minneapolis, Minn.	1.05	1.05	ND	<5	5	8	ND	<5
New Orleans, La.	1.33	1.26	ND	<5	10	13	10	<5
New York, N.Y.	[2]	1.14	[2]	<5	[2]	9	[2]	5
Norfolk, Va.	1.28	1.21	ND	<5	7	9	ND	<5
Oklahoma City, Okla.	1.28	1.19	ND	<5	6	7	ND	<5
Omaha, Nebr.	1.08	1.05	ND	<5	6	7	ND	5
Palmer, Alaska.	1.15	1.07	ND	<5	8	7	ND	10
Philadelphia, Pa.	1.26	1.18	ND	<5	6	8	ND	5
Phoenix, Ariz.	1.06	1.03	ND	<5	3	4	ND	10
Pittsburgh, Pa.	1.19	1.21	ND	<5	8	12	ND	5
Portland, Maine.	1.24	1.15	ND	<5	10	11	ND	15
Portland, Oreg.	1.11	1.12	ND	<5	9	10	10	25
Providence, R.I.	1.22	1.21	ND	<5	9	11	15	10
Sacramento, Calif.	1.22	1.09	ND	<5	4	5	ND	<5
Salt Lake City, Utah.	1.10	1.10	ND	<5	4	6	ND	5
San Francisco, Calif.	1.03	1.11	ND	<5	3	4	ND	10
San Juan, P.R.	1.14	1.16	ND	<5	4	4	ND	<5
Seattle, Wash.	1.12	1.09	ND	<5	6	8	10	25
Spokane, Wash.	1.14	1.09	ND	<5	10	8	5	15
St. George, Utah.	1.14	1.06	ND	<5	2	4	10	5
St. Louis, Mo.	1.02	1.04	ND	<5	7	7	10	30
Syracuse, N.Y.	1.13	1.22	ND	<5	6	7	ND	10
Tampa, Fla.	1.31	1.27	ND	<5	6	5	40	70
Trenton, N.J.	1.22	1.22	ND	<5	6	8	ND	<5
Washington, D.C.	1.22	1.18	ND	<5	6	8	5	<5
Wichita, Kans.	1.10	1.08	ND	<5	3	6	ND	<5
Wilmington, Del.	1.24	1.21	ND	<5	8	8	ND	5

[1] Because this program was initiated in 1960 and sampling necessarily became operative in a staggered sequence, the averages shown represent all analyses to date. Average will normally be for the latest 12-month period after sampling began. For the January data, the average covers 5 to 11 analyses.

[2] Sample lost.

[3] ND—No detectable activity.

Radioactivity in Milk

Health and Safety Laboratory, U.S. Atomic Energy Commission

The results of the Atomic Energy Commission's Health and Safety Laboratory's routine milk monitoring program at four locations in the United States for September, October, and November 1960 are presented in table 1. Data for previous months appear in *Radiological Health Data*, volume I, Nos. 1, 2, 3, 5, 7 and 8, and volume II, No. 3.

The Health and Safety Laboratory has published a correction for the results of the August 1960 sample collected at Perry, N.Y., included in the data in volume II, No. 3. The corrected results are shown in table 1.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN MILK SAMPLES, 1960 [1]

Health and Safety Laboratory

Sampling station and month	Strontium-90			Calcium	
	μμc/liter	μμc/kg	μμc/gmCa	gm/liter	gm/kg
Perry, N.Y. (powdered milk):					
August (correction)	----------	49.7	5.5	----------	9.1
September	----------	39.7	4.96	----------	8.0
October	----------	45.6	5.10	----------	8.95
November	----------	37.8	4.17	----------	9.08
New York City (liquid milk):					
September	6.3	----------	6.1	1.03	----------
October	6.2	----------	6.1	1.02	----------
November	6.4	----------	5.9	1.09	----------
Mandan, North Dakota (powdered buttermilk):					
September	----------	100	9.1	----------	11.0
October	----------	84	8.1	----------	10.4
November	----------	109	9.1	----------	11.9
Honolulu, Hawaii [2] (liquid milk):					
September	3.7	----------	3.4	1.1	----------
	2.4	----------	2.3	1.0	----------
October	3.4	----------	3.2	1.1	----------
	2.8	----------	2.7	1.0	----------
November	2.8	----------	2.7	1.0	----------
	1.9	----------	1.8	1.0	----------

[1] Data from quarterly Summary Report, HASL-111, dated Apr. 1, 1961.
[2] 2 results per month representing milk from 2 dairies.

Strontium-90 in Bovine Milk From Minnesota

Division of Environmental Sanitation, Minnesota Department of Health

The Minnesota Department of Health, Division of Environmental Sanitation, initiated an intrastate bovine milk surveillance network in September 1958. Two-ounce samples, collected daily at each of the network stations, are composited and analyzed monthly. Collection is made at the bottling machines so that the sample is randomly representative of the milk produced in that milkshed.

Results for the period January through April 1960 were published in *Radiological Health Data*, Volume I, Number 9. The most recently reported data from this network are presented below.

TABLE 1.—STRONTIUM-90 IN BOVINE MILK FROM MINNESOTA

May–November 1960

[Concentrations in μμc/liter]

Month	Brainerd	Duluth	Minneapolis	Thief River Falls	Worthington	Rochester
May	----------	----------	9.4	17.9	9.4	9.2
June	16.9	12.5	9.7	7.8	8.8	8.0
July	10.6	13.1	8.3	----------	8.6	8.7
August	----------	7.4	6.2	7.3	4.9	6.4
September	----------	11.0	3.9	4.4	3.7	3.7
October	----------	9.9	6.2	6.2	5.5	5.0
November	----------	12.6	6.4	6.2	4.2	4.6

SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network was established under the provision of section 4(c) of Public Law 660, which states " * * * The Surgeon General shall * * * collect and disseminate basic data * * * (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present, there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of 250 to 300 stations will be in operation. A few of the more recently established stations have not begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributable solely to natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River.

While beta determinations for the first 2 years of the Network operation have been conducted on each sample weekly, the alpha determinations are reported generally on a composite sample of more than 1 week. Beginning with samples taken in January 1960, beta determinations were performed on composite samples obtained by combining two or more weekly samples. The alpha data are reported for 3-month composite samples, with one-quarter of the stations being covered each month. All the data reported in table 1 represent the average of all information available for the month indicated.

Strontium-90 data reported are the results of determinations on composite samples for a 3-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.50.
2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, volume 1, May 1959, pages 167–169.
3. Setter, L. R., Regnier, J. E., and Diephaus, A., "Radioactivity of Surface Waters in the United States," Jour. AWWA *51*. 1377 (1955).
4. Straub, C. P., Setter, L. R., Goldin, S., and Hallbach, P. F., "Strontium-90 in Surface Waters," Jour. AWWA *52*, 756 (1956).
5. Setter, L. R., and Baker, S. L., "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, volume I, No. 7 (1960).

FIGURE 1.—PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

As of June 30, 1960

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

National Water Quality Network, Public Health Service

[Concentrations in μμc/liter]

Station	Quarter ending Dec. 31, 1960	December 1960					
		Beta activity			Alpha activity		
	Strontium-90	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Animas River: Cedar Hill, N. Mex.		111	35	146	29	26	55
Chattahoochie River:							
Atlanta, Ga.	0.3	0	0	0			
Columbus, Ga.		0	<1	<1	0	2	2
Colorado River:							
Loma, Colo.		0	0	0	0	11	11
Page, Ariz.	.4	0	20	20	<1	17	18
Hoover Dam, Ariz.-Nev.		0	10	10	0	13	13
Parker Dam, Ariz.-Calif.	1.2	0	10	10	0	10	10
Yuma, Ariz.		0	0	0	0	8	8
Columbia River:							
Pasco, Wash.		54	724	778			
Bonneville Dam, Oreg.	.5	27	401	428	1	2	3
Clatskanie, Oreg.		3	137	140			
Delaware:							
Martin's Creek, Pa.		0	0	0			
Philadelphia, Pa.		3	3	6	1	1	2
Escambia River: Century, Fla.	(1)	0	0	0	0	0	0
Great Lakes:							
Gary, Ind.		0	0	0	0	0	0
Detroit, Mich.		0	0	0	0	1	1
Milwaukee, Wis.	.2	0	1	1	0	0	0
Hudson River: Poughkeepsie, N.Y.	.4	0	0	0			
Illinois River: Peoria, Ill.	.5	0	0	0	1	3	4
Kanawha River: Winfield Dam, W. Va.		0	0	0	0	1	1
Klamath River: Copco, Oreg.		0	4	4	<1	1	2
Little Miami River: Cincinnati, Ohio	(1)	0	0	0	0	2	2
Mississippi River:							
East St. Louis, Ill.		0	0	0	0	2	2
Cape Girardeau, Mo.		0	9	9	2	7	9
West Memphis, Ark.	1.0	0	4	4	1	2	3
Missouri River:							
Yankton, S. Dak.		0	1	1	0	13	13
St. Joseph, Mo.	.5	0	5	5	1	6	7
Kansas City, Kans.		0	5	5	3	3	6
St. Louis, Mo.		0	0	0			
Ohio River:							
East Liverpool, Ohio		0	3	3			
Wheeling, W. Va.	.6						
Huntington, W. Va.	.4	0	0	0	0	1	1
Evansville, Ind.	.8	0	<1	<1	0	<1	<1
Cairo, Ill.		2	9	11			
Potomac River: Williamsport, Md.		0	0	0	0	0	0
Red River, North: Grand Forks, N. Dak.		0	7	7	1	7	8
Red River, South:							
Denison, Tex.	.7	0	0	0	0	10	10
Index, Ark.		11	3	14	7	4	11
Rio Grande River:							
Alamosa, Colo.		0	0	0	<1	2	3
El Paso, Tex.		0	0	0			
Laredo, Tex.		0	5	5	9	5	14
Brownsville, Tex.		2	0	2	0	10	10
Sabine River: Ruliff, Tex.		0	4	4	<1	0	<1
St. Clair River: Port Huron, Mich.		0	0	0	0	<1	<1
St. Lawrence River: Massena, N.Y.	.6	0	1	1	0	<1	<1
St. Mary's River: Sault Ste. Marie, Mich.		0	2	2	0	1	1
Savannah River:							
Port Wentworth, Ga.	.5	0	16	16			
North Augusta, S.C.		0	0	0	0	0	0
Snake River:							
Wawawai, Wash.		0	0	0	0	6	6
Weiser, Idaho	.2	0	0	0	0	6	6
Susquehanna River:							
Sayre, Pa.		0	0	0	0	0	0
Conowingo, Md.	.4	0	5	5	0	1	1
Tennessee River:							
Chattanooga, Tenn.	.9	0	47	47			
Bridgeport, Ala.		0	69	69	0	1	1
Yellowstone River: Sidney, Mont.		0	0	0	4	10	14

[1] Insufficient sample for analysis.

Monitoring of Water Supplies Around the Nevada Test Site

By contract with the Atomic Energy Commission the Public Health Service has conducted an offsite monitoring program around the Nevada Test Site (NTS) since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23d semiannual reports to Congress and by the Public Health Service in the 1957 Congressional Hearings entitled, "The Nature of Radioactive Fallout and Its Effects on Man."

Figure 1 summarizes gross beta measurements in water supplies located in the NTS offsite area for the 2-month period, January–February 1961.

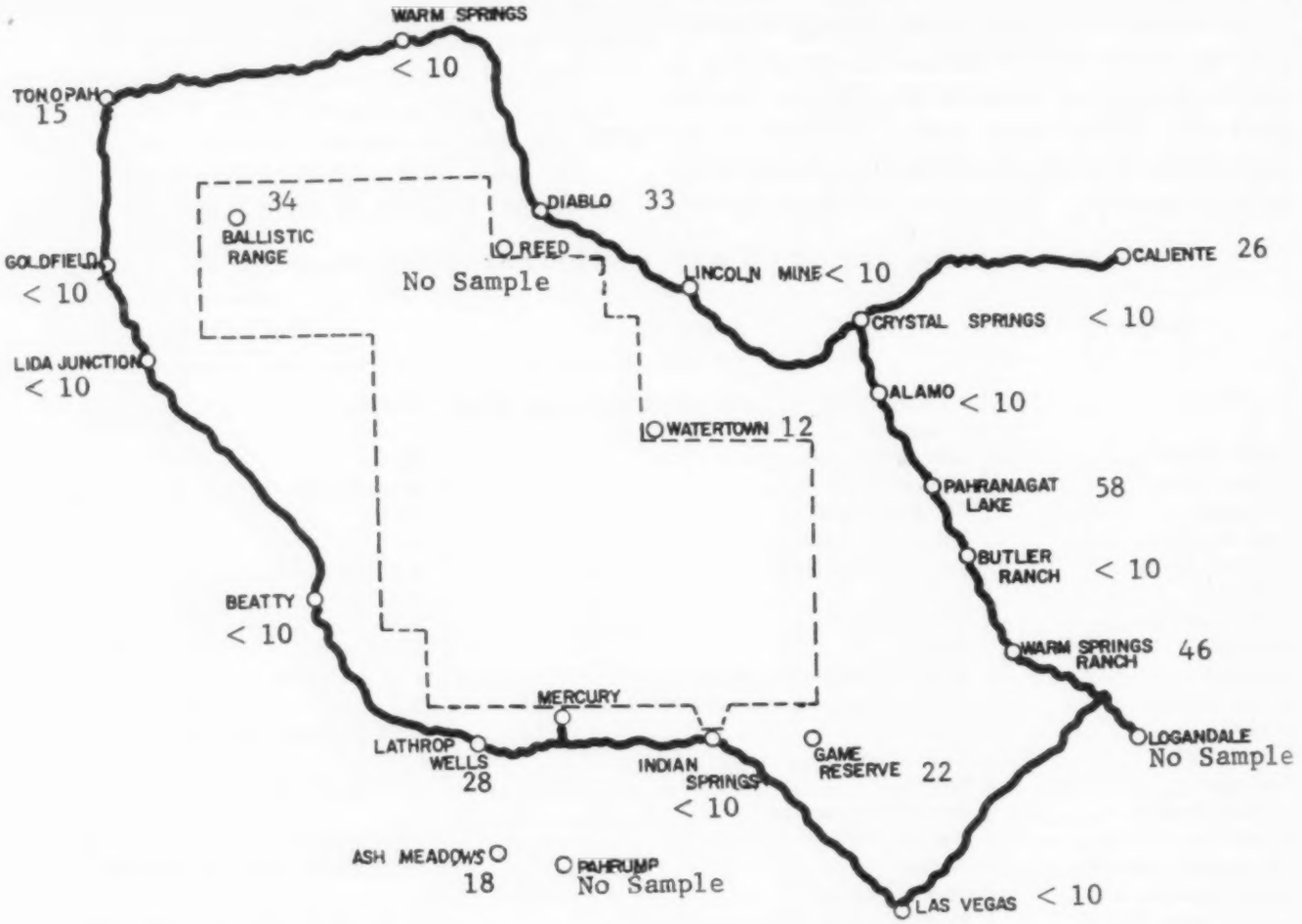
The lower limit of detectability with the equipment used is about 10 micromicrocuries per liter.

TABLE 1.—DESCRIPTION OF WATER SAMPLING POINTS, *Nevada Test Site*

Location	Source	Population served
Las Vegas	13 wells—650′ to 1,250′ depth plus Lake Mead supply.	40,000.
Game Reserve	400′ drilled well	20.
Indian Springs	600′ drilled well	Average 250.
Pahrump	75′ driven well	10–50.
Ash Meadows	Spring 25′ deep	8.
Lathrop Wells	3 wells—600′ deep	Average 15.
Beatty	Spring	550.
Lida Junction	125′ drilled well	2–10.
Goldfield	Spring	Average 200.
Tonapah	2 drilled wells—60′ depth	Average 1,500.
Warm Springs	Multiple springs—no improvement	10.
Diablo	Well	State Highway Station.
Lincoln Mine	2 driven wells	3.
Caliente	Springs	Average 10–12.
Crystal Springs	Free flowing spring	0.
Alamo	2 wells—50′–67′ deep	Average 175.
Pahranagat Lake	Surface	Not used for domestic purposes.
Butler Ranch	Flowing spring	1.
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool.
Logandale	Drilled well	300.
Ballistic Range	do	10–15.

FIGURE 1.—GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFFSITE AREAS OF THE NEVADA TEST SITE FOR JANUARY–FEBRUARY 1961

[Average concentrations in μμc/liter at time of measurement]



Strontium-90 in Tap Water

Health and Safety Laboratory, Atomic Energy Commission

The Atomic Energy Commission's Health and Safety Laboratory monitors tap water concentrations of strontium-90 in Richmond, Calif., and New York City on a monthly basis. Data for the fourth quarter 1960 are presented below. Previous data for 1960 were given in *Radiological Health Data*, volume I, Nos. 5 and 9, and volume II, No. 4.

TABLE 1.—STRONTIUM-90 IN TAP WATER, FOURTH QUARTER 1960 [1]

Location	Month	Activity (μμc/liter)
Richmond, Calif. (40 liters per sample)	October	0.26
	November	.28
	December	.26
New York City (100–200 liters per sample)	October	.33
	November	.34
	December	.34

[1] Data from *Quarterly Summary Report, HASL-111*, dated Apr. 1, 1961.

SECTION V.—OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately 3 feet above the ground. These readings are not precise but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY

Public Health Service, Radiation Surveillance Network, January 1961

Station location	Average (mr/hr)	Station location	Average (mr/hr)	Station location	Average (mr/hr)
Anchorage, Alaska	0.01	Iowa City, Iowa	.02	Ponca City, Okla	.04
Fairbanks, Alaska	[1]	Topeka, Kans	.02	Portland, Oreg	.02
Juneau, Alaska	.01	New Orleans, La	.02	Harrisburg, Pa	.01
Phoenix, Ariz	.01	Baltimore, Md	.02	Providence, R.I	.02
Little Rock, Ark	.02	Lawrence, Mass	.02	Columbia, S.C	.02
Berkeley, Calif	.01	Lansing, Mich	.02	Edgemont, S. Dak	[1]
Los Angeles, Calif	.01	Minneapolis, Minn	.01	Pierre, S. Dak	.02
Denver, Colo	.02	Pascagoula, Miss	[1]	Austin, Tex	.01
Hartford, Conn	.01	Jefferson City, Mo	.01	El Paso, Tex	.02
District of Columbia	.02	Helena, Mont	.03	Salt Lake City, Utah	.02
Jacksonville, Fla	.02	Trenton, N.J	[1]	Richmond, Va	.01
Atlanta, Ga	[1]	Santa Fe, N. Mex	.04	Seattle, Wash	.02
Honolulu, Hawaii	.02	Albany, N.Y	.02	Madison, Wis	.01
Boise, Idaho	.01	Gastonia, N.C	.02	Cheyenne, Wyo	.02
Springfield, Ill	[1]	Cincinnati, Ohio	[1]		
Indianapolis, Ind	.01	Oklahoma City, Okla	.02		

[1] No data received.

Radioactivity in the Biota Near Hanford, Hanford Atomic Products Operation

General Electric Co., Richland, Wash.

During operation of the plutonium production and research facilities at the Hanford Atomic Products Operation (HAPO), operated by General Electric Co. for the Atomic Energy Commission, controlled amounts of radioactive wastes are released to the atmosphere, ground, and Columbia River. These wastes contribute to the radiation exposure of persons living in the neighborhood of the controlled area. The protection of these persons from undue radiation exposure attributable to

Hanford sources is one of the attendant responsibilities in the operation of the Hanford facilities. A summary of results concerning levels of radioactivity in air and water for the environs of Hanford during the calendar year 1959 and the first and second quarters of 1960 appear in *Radiological Health Data*, volume II, No. 5.

The following tables have been abstracted from HAPO's quarterly reports entitled "Evaluation of Radiological Conditions in the Vicinity of Hanford," for the first, second, and third quarters of 1960, issued May 31, August 5, and November 10, 1960 respectively.

These tables present data regarding levels of specific radionuclides in grass, vegetables, alfalfa, milk, fish, fowl, and oysters at selected locations.

Located downstream nearest to the HAPO plant are the Ringold farms and the Riverview Irrigation District, which use Columbia River water for irrigation. These farming areas are located about 15 and 30 miles downstream, respectively, from the nearest reactor. The farms in both areas are relatively small and so diversified that their harvests contribute only a small fraction of produce consumed in nearby communities. However, their locations with respect to the reactors should result in the maximum concentrations of radionuclides in produce for those radionuclides associated with irrigation water.

Atmospheric concentrations generally result in the uptake of radionuclides by plant life. Therefore, the surveillance program at Hanford includes the sampling of native grasses from several locations throughout the Pacific Northwest. These locations are identified as zones in figure 1. The sampling procedure consisted of collecting 15 grams of grass at each of 10 sites throughout a zone. The samples within zones were composited and analyzed by use of a gamma spectrometer. The analytical results are given in table 1.

FIGURE 1.—VEGETATION SAMPLING ZONE LOCATIONS, HANFORD WORKS AND ENVIRONS

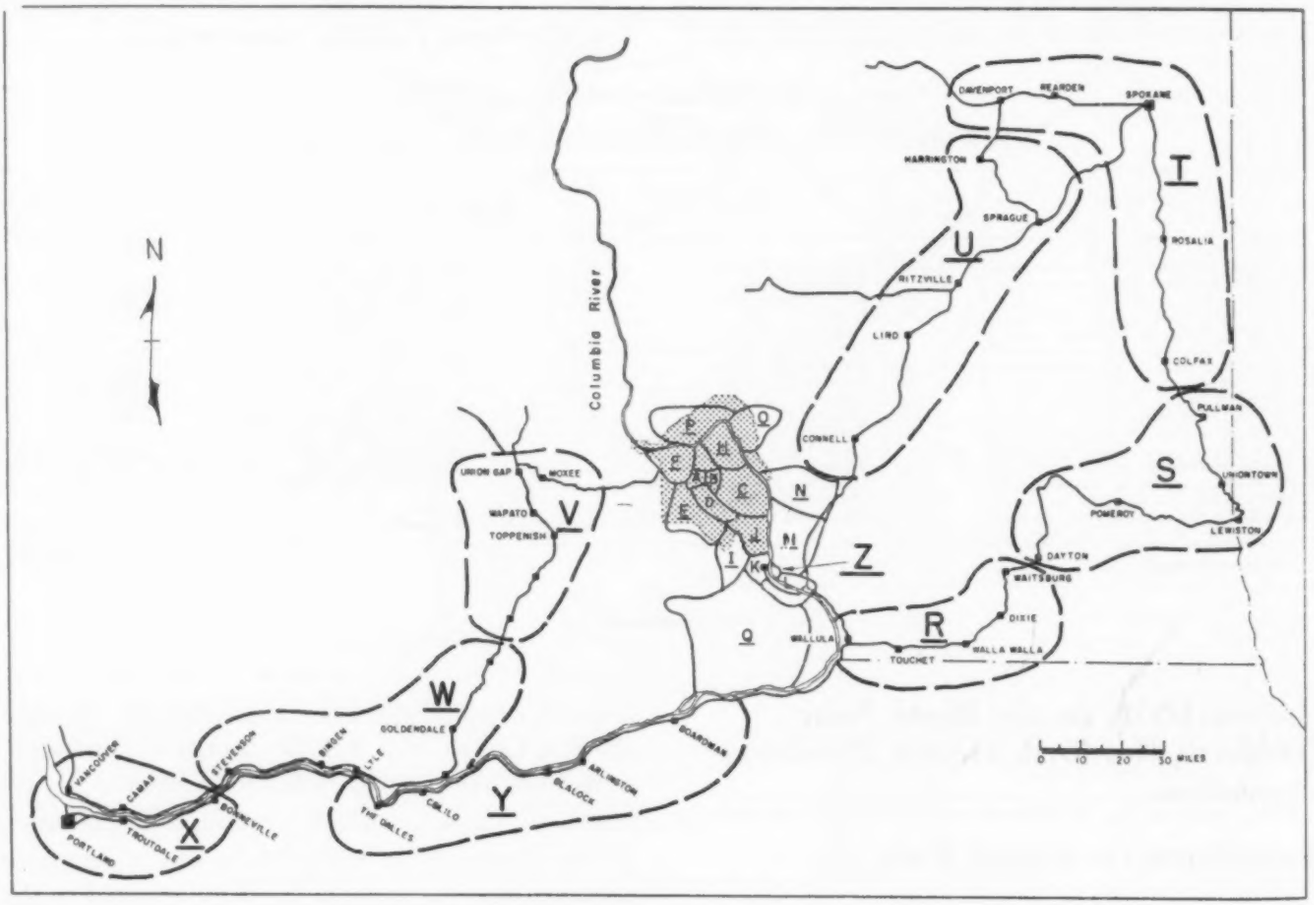


TABLE 1.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN NATIVE GRASSES—1960

[Average concentrations in μμc/gm of vegetation]

Radionuclide(s)	Quarter	Statistic	Zone															
			I	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Ba^{140}-La^{140}	1st	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	2d	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	3d	Number of samples	13	13	13	13	13	13	13	12	8	8	8	8	9	9	9	9
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Zr^{95}-Nb^{95}	1st	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	2d	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	3d	Number of samples	13	13	13	13	13	13	13	12	8	8	8	8	9	9	9	9
		Average	<2.0	<2.0	<2.0	<2.0	<3.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Ru^{103}+Ru^{106}	1st	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	3.7	3.5	3.2	4.6	2.7	4.1	3.1	4.3	4.2	4.7	5.0	3.4	<2.0	5.0	6.5	2.6
	2d	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	3d	Number of samples	13	13	13	13	13	13	13	12	8	8	8	8	9	9	9	9
		Average	<2.0	<2.0	<2.0	<2.0	<2.0	2.6	<2.0	<2.0	2.2	2.8	2.5	2.3	<2.0	2.5	3.1	<2.0
I^{131}	1st	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	3.0	2.3	<1.5	1.8	<1.5	1.7	2.5	2.2	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	2d	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	3d	Number of samples	13	13	13	13	13	13	13	12	8	8	8	8	9	9	9	9
		Average	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Ce^{141}+Ce^{144}	1st	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	10.2	11.2	12.9	12.9	10.2	11.2	12.6	13.4	17.7	21.7	29.3	16.0	6.6	25.7	19.3	13.7
	2d	Number of samples	13	13	13	13	13	13	13	13	3	3	3	3	3	3	3	3
		Average	7.8	<5.0	<5.0	<5.0	<5.0	<5.0	6.4	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.3	<5.0
	3d	Number of samples	13	13	13	13	13	13	13	12	8	8	8	8	9	9	9	9
		Average	6.2	5.4	5.7	7.0	7.1	8.2	6.5	6.5	9.8	10.6	12.6	9.0	5.2	11.8	10.3	7.9

TABLE 2.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN NATIVE GRASSES, ZONE Z, 1960

[Average concentrations in μμc/gm of vegetation]

Quarter	Statistic	Radionuclide(s)							
		Ba^{140}–La^{140}	Zn^{65}	Zr^{95}–Nb^{95}	Cs^{137}	Ru^{103}+Ru^{106}	I^{131}	Cr^{51}	Ce^{141}+Ce^{144}
1st	Number of samples	13	13	13	13	13	13	13	13
	Average	<2.0	1.6	<2.0	1.2	2.7	<1.5	<5.0	12.1
2d	Number of samples	13	13	13	13	13	13	13	13
	Average	<2.0	2.0	<2.0	<1.0	<2.0	<1.5	<5.0	<5.0
3d	Number of samples	13	13	13	13	13	13	13	13
	Average	<2.0	2.9	<2.0	<1.0	<2.0	<1.5	<5.0	5.3

TABLE 3.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN ALFALFA PURCHASED FROM GROWERS AT SELECTED WASHINGTON LOCATIONS, 1960

[Average concentrations in μμc/gm]

Isotope(s)	1st quarter				2d quarter								3d quarter	
	Walla Walla		Spokane		Riverview Irrigation District, Pasco		Ringold		Benton City		Eltopia		Riverview Irrigation District, Pasco	
	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average
Sc^{46}	1	<0.1	2	<0.1	7	0.27	4	0.14	4	<0.1	4	<0.1	7	0.23
K^{40}	1	15	2	7.7	7	8.2	4	8.0	4	4.9	4	6.8	7	7.6
Zn^{65}	1	<0.1	2	<.1	7	2.2	4	2.4	4	<.1	4	.2	7	1.7
Zr^{95}-Nb^{95}	1	.17	2	.84	7	<.1	4	.1	4	<.1	4	<.1	7	.2
Cs^{137}	1	.12	2	.16	7	<.05	4	.05	4	<.05	4	<.05	7	<.05
Ru^{103}+Ru^{106}	1	1.6	2	2.2	7	<.5	4	.5	4	<.5	4	.5	7	.7
I^{131}	1	<.1	2	<.1	7	<.1	4	<.1	4	.1	4	.1	7	<.1
Cr^{51}	1	<.5	2	<.5	7	5.4	4	3.5	4	<.5	4	<.5	7	19.6
Ce^{141}+Ce^{144}	1	1.4	2	3.1		[1] NA		NA		NA		NA		NA
Ce^{144}–Pr^{144}		[1] NA		NA	7	1.1	4	1.6	4	<.5	4	.4	7	1.8
Sr^{89}	1	.89	2	.12	2	[2] .20	4	[3] NC	4	NC	1	<.01	4	.02
Sr^{90}	1	.15	2	.14	2	[2] .35	4	NC	4	NC	1	.03	4	.07
P^{32}		NA	2	NA	5	.34	3	.58	3	.08	3	<.01	7	1.44

[1] NA—Not analyzed. [2] Questionable results. [3] NC—Analysis not completed at time of report.

TABLE 4.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN VEGETABLES PURCHASED FROM GROWERS AT SELECTED WASHINGTON LOCATIONS, 3D QUARTER 1960

[Average concentrations in μμc/gm vegetable]

Location	Crop	Sc^{46}		K^{40}		Zn^{65}		Zn^{95}-Nb^{95}		Cs^{137}		Ru^{103}+Ru^{106}	
		Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average
Riverview Irrigation District.	Beets	1	<0.1	1	4.2	1	<0.1	1	0.49	1	<0.05	1	<0.5
	Cantaloupes	2	<.1	2	3.6	2	.18	2	<.1	2	<.05	2	<.5
	Carrots	3	<.1	3	4.0	3	.11	3	.19	3	<.05	3	<.5
	Corn	4	.21	4	1.9	4	.95	4	<.1	4	<.05	4	<.5
	Cucumber	1	<.1	1	1.3	1	<.1	1	<.1	1	<.05	1	<.5
	Grapes	1	<.1	1	3.2	1	.10	1	<.1	1	<.05	1	<.5
	Peaches	1	<.1	1	2.1	1	<.1	1	<.1	1	<.05	1	<.5
	Tomatoes	2	<.1	2	2.3	2	<.1	2	<.1	2	<.05	2	<.5
	Watermelon	1	<.1	1	1.8	1	.15	1	<.1	1	<.05	1	<.5
Benton City	Apricots	1	<.1	1	2.8	1	<.1	1	<.1	1	<.05	1	<.5
	Barley	1	<.1	1	5.5	1	.13	1	<.1	1	<.05	1	<.5
	Cabbage	1	<.1	1	2.3	1	<.1	1	<.1	1	<.05	1	<.5
	Corn	3	<.1	3	2.6	3	<.1	3	<.1	3	<.05	3	<.5
	Cucumbers	2	<.1	2	1.3	2	<.1	2	<.1	2	<.05	2	<.5
	Peaches	1	<.1	1	2.0	1	<.1	1	<.1	1	<.05	1	<.5
	Pears	1	<.1	1	1.8	1	<.1	1	<.1	1	<.05	1	<.5
	Tomatoes	1	<.1	1	1.3	1	<.1	1	<.1	1	<.05	1	<.5
	Rye	1	<.1	1	4.4	1	.15	1	<.1	1	<.05	1	<.5
	Wheat	1	<.1	1	4.2	1	.12	1	<.1	1	<.05	1	<.5
Ringold and vicinity	Apricots	3	<.1	3	2.2	3	<.1	3	<.1	3	<.05	3	<.5
	Corn	1	<.1	1	1.9	1	.21	1	<.1	1	<.05	1	<.5
	Peaches	1	<.1	1	2.0	1	<.1	1	<.1	1	<.05	1	<.5

Location	Crop	I^{131}		Cr^{51}		Ce^{141}+Ce^{144}		Sr^{89}		Sr^{90}		P^{32}	
		Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average
Riverview Irrigation District.	Beets	1	<0.1	1	0.72	1	<0.5	1	<0.01	1	0.013	1	[1] SL
	Cantaloupes	2	<.1	2	<.5	2	<.5	2	<.01	2	<.006	2	<.1
	Carrots	3	<.1	3	.90	3	<.5	2	<.01	2	.010	2	.12
	Corn	4	<.1	4	<.5	4	<.5	3	<.01	3	<.006	4	.29
	Cucumber	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Grapes	1	<.1	1	<.5	1	<.5	1	[2] NC	1	NC	1	<.1
	Peaches	1	<.1	1	<.5	1	<.5	1	NC	1	NC	1	<.1
	Tomatoes	2	<.1	2	<.5	2	<.5	1	<.01	1	<.006	2	<.1
	Watermelon	1	<.1	1	<.5	1	<.5	1	NC	1	NC	1	<.1
Benton City	Apricots	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Barley	1	<.1	1	<.5	1	<.5	1	<.01	1	.034	1	<.1
	Cabbage	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Corn	3	<.1	3	<.5	3	<.5	1	<.01	1	<.006	3	<.1
	Cucumbers	2	<.1	2	<.5	2	<.5	2	<.01	2	.006	2	<.1
	Peaches	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Pears	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Tomatoes	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1
	Rye	1	<.1	1	<.5	1	<.5	1	.031	1	.051	1	<.1
	Wheat	1	<.1	1	<.5	1	<.5	1	NC	1	NC	1	<.1
Ringold and vicinity	Apricots	3	<.1	3	<.5	3	<.5	3	<.01	3	<.006	3	<.1
	Corn	1	<.1	1	<.5	1	<.5	1	NC	1	NC	1	<.1
	Peaches	1	<.1	1	<.5	1	<.5	1	<.01	1	<.006	1	<.1

[1] SL—Sample lost. [2] NC—Analysis not completed at the time of the report.

TABLE 5.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN MILK PURCHASED FROM PRODUCERS AT SELECTED WASHINGTON LOCATIONS, 1960

[Average concentrations in μμc/gm milk]

Location	K^{40}		Zn^{65}		Cs^{137}		Sr^{89}		Sr^{90}		P^{32}	
	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average
1st quarter												
Riverview Irrigation District:												
Farm 2	8	1.2	8	0.24	8	0.034	5	<0.004	5	0.0045	----------	[1] NA
Farm 3	6	1.0	6	.40	6	< .030	2	< .004	2	.0056	----------	NA
Ringold Farms	6	2.1	6	.32	6	.074	3	< .004	3	.0029	----------	NA
Benton City	2	1.7	2	< .08	2	< .030	2	< .004	2	.0025	----------	NA
Local purchase—commercial milk:												
Brand A	2	1.3	2	< .08	2	< .030	1	< .004	1	.0051	----------	NA
Brand F	2	1.3	2	< .08	2	< .030	1	< .004	1	.0038	----------	NA
Brand H	2	1.3	2	< .08	2	.048	2	< .004	2	.0056	----------	NA
2d quarter												
Riverview Irrigation District:												
Farm 2	3	1.6	3	0.51	3	0.022	1	<0.004	1	0.0057	----------	NA
Ringold Farms	3	1.6	3	.63	3	< .030	1	< .004	1	.0043	----------	NA
Benton City	1	1.8	1	< .08	1	< .030	1	< .004	1	.0051	----------	NA
Local purchase—commercial milk:												
Brand A	2	1.5	2	< .08	2	< .030	1	< .004	1	.0045	----------	NA
Brand F	2	1.5	2	< .08	2	.030	1	< .004	1	.0029	----------	NA
Brand H	2	1.4	2	< .08	2	.039	1	< .004	1	.0140	----------	NA
3d quarter												
Riverview Irrigation District	10	1.3	10	0.75	10	<0.030	2	<0.004	2	0.0029	6	0.95
Ringold Farms	12	1.2	12	.65	12	.025	5	< .004	5	.0033	9	1.40
Benton City	2	1.1	2	< .08	2	< .030	2	NA	2	NA	2	NA
Local purchase—commercial milk: Brand F	3	1.1	3	< .08	3	< .030	3	NA	3	NA	3	NA

[1] NA—Not analyzed.

TABLE 6.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN LOCALLY PURCHASED CONDENSED, EVAPORATED OR FORMULA MILK, WASHINGTON, 1960

[Average concentrations in μμc/gm milk]

Brand	K^{40}				Cs^{137}				Sr^{89}				Sr^{90}			
	2d quarter		3d quarter		2d quarter		3d quarter		2d quarter		3d quarter		2d quarter		3d quarter	
	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average	Number samples	Average
J	1	1.2	1	1.4	1	<0.030	1	0.047	1	<0.004	1	<0.004	1	0.017	1	0.004
C	1	2.6	1	2.6	1	.035	1	.034	1	.013	1	< .004	1	.020	1	.011
L	1	4.3	1	2.5	1	.230	1	< .030	1	< .004	1	< .004	1	.031	1	.008
K	1	2.6	1	2.6	1	.050	1	< .030	1	< .004	1	< .004	1	.014	1	.009
T	1	3.2	1	2.4	1	.071	1	< .030	1	< .004	1	< .004	1	.005	1	.004
R	1	2.3	1	1.7	1	.033	1	.082	1	< .004	1	< .004	1	.032	1	.029

TABLE 7.—CONCENTRATIONS OF P^{32} IN SELECTED ORGANISMS, 1960

[Average concentrations in μμc/gm of wet tissue]

Quarter	Type of fish or water fowl	Location	Number samples	Average
1st	White fish, flesh	River, Ringold area	3	320
	do	River, Priest Rapids area	1	7
	do	River, near reactors	1	21
	Diving ducks	do	7	2,100
	River ducks	do	9	200
	Minnows, entire fish	do	7	1,000
	Salmon, juvenile entire fish	do	1	26
2d	Minnows, entire fish	do	30	3,290
	Salmon, juvenile entire fish	do	11	2,960
3d	Minnows, entire fish	do	10	9,400
	Shiners	do	30	25,000

TABLE 8.—CONCENTRATIONS OF SEVERAL RADIONUCLIDES IN OYSTERS, WILLAPA BAY, WASHINGTON, THIRD QUARTER 1960

[Average concentrations in μμc/gm]

Isotope(s)	Number samples	Average
Sc^{46}	4	0.13
K^{40}	4	2.6
Zn^{65}	4	58
$Zr^{95}-Nb^{95}$	4	.28
Cs^{137}	4	<.05
$Ru^{106}+Ru^{106}$	4	<.5
I^{131}	4	<.1
Cr^{51}	4	<.5
$Ce^{141}+Ce^{144}$	4	<.5
Sr^{89}	2	<.004
Sr^{90}	2	<.002
p^{32}	2	.68

ENVIRONMENTAL LEVELS OF RADIOACTIVITY AT ATOMIC ENERGY COMMISSION INSTALLATIONS

The U.S. Atomic Energy Commission is providing data on environmental levels of radioactivity in the vicinity of major Commission installations to the Public Health Service on a quarterly basis. The data are from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Radiological Health Data, volume I, Nos. 8 and 9; and volume II, Nos. 1, 2, 3, 4, and 5 contain summaries for 17 installations. Summaries follow for the Aircraft Nuclear Propulsion Department, Brookhaven National Laboratory and the Feed Materials Production Center for the third and fourth quarters of 1960.

Aircraft Nuclear Propulsion Department

General Electric Co., Cincinnati, Ohio, Issued December 1960 and February 1961

Environmental levels of radioactivity at the Aircraft Nuclear Propulsion Department (ANPD) for 1959 and the first and second quarters 1960 were reported in *Radiological Health Data*, volume I, No. 8 and volume II, No. 2. The following report presents a summary of the data for the third and fourth quarters of 1960 as well as the 1960 annual summary.

The Cincinnati facilities of the ANPD are located within the metropolitan area approximately 11 miles north of the main business district. The buildings lie approximately on the centerline of a wide valley at an elevation of 560 feet above sea level. The east fork of Mill Creek, which flows into the Ohio River, runs several hundred feet east of the buildings. (See figs. 1 and 2.)

Air Monitoring

The offsite (community) monitoring program for alpha and beta-gamma airborne radioactivity is accomplished by the use of a mobile sampling unit. Offsite measurements taken by the mobile unit are considered as a check or verification of the sampling data obtained by the stack effluent air monitoring program.

Sampling is generally confined to the communities and General Electric sites within a 1-mile radius of the ANPD. This area is divided into eight sectors, each of which is subdivided at quarter-mile distances. (See fig. 2.) Choice of an optimum sampling location is based upon consid-

FIGURE 1.—LOCATION MAP, AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

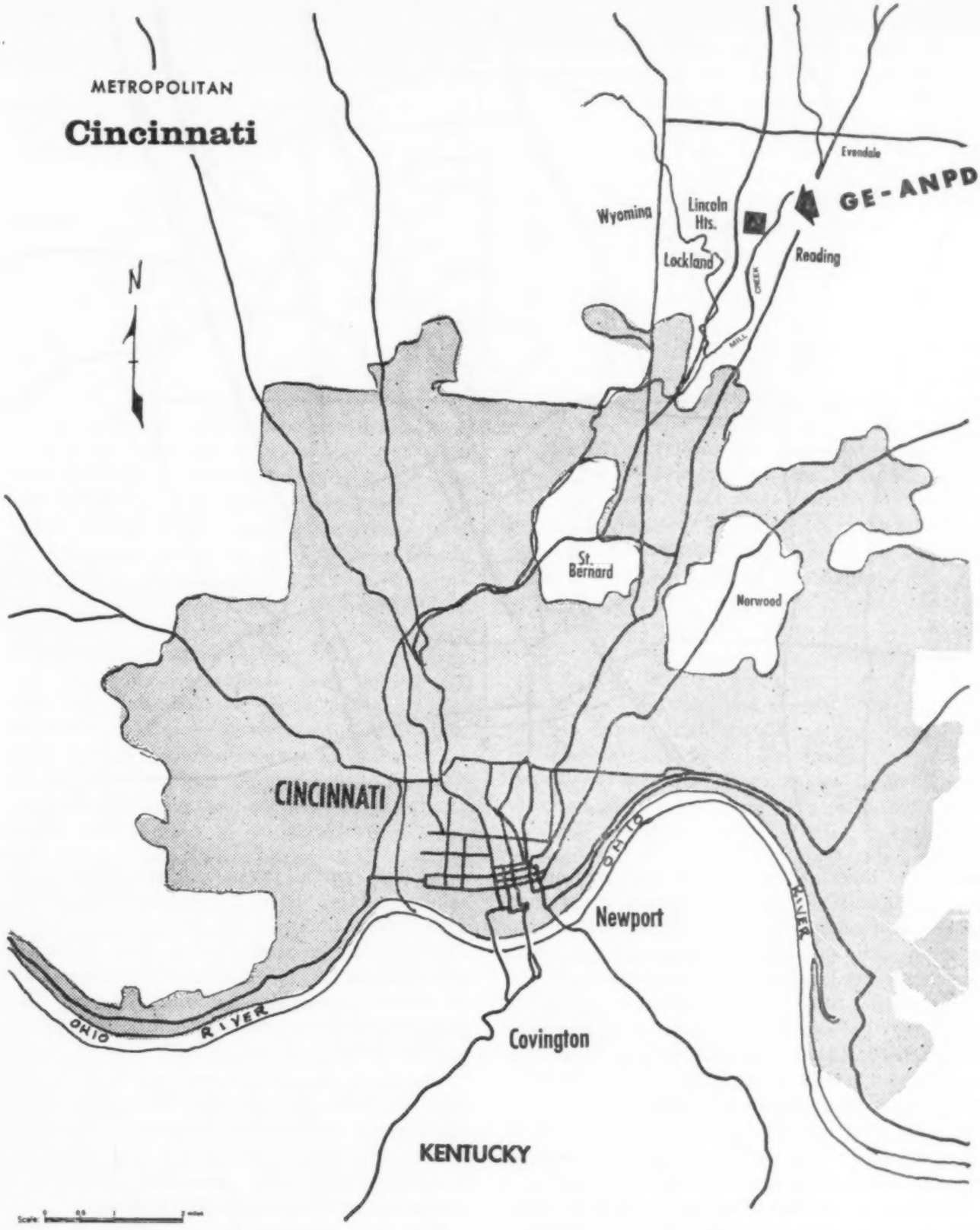
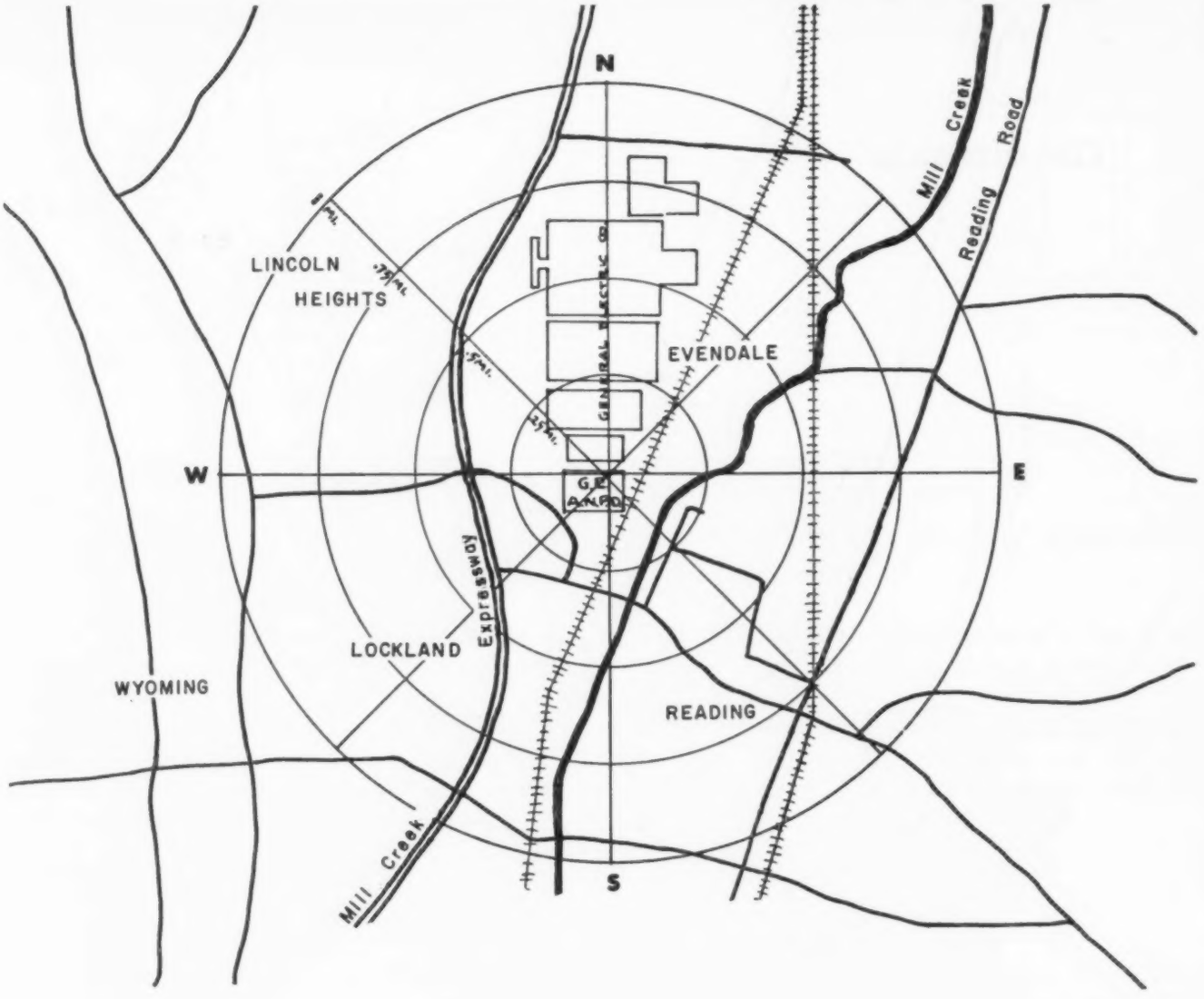


FIGURE 2.—SITE MAP, AIRCRAFT NUCLEAR PROPULSION DEPARTMENT



erations of direction, speed, and behavior of the winds. Information on these factors is obtained from an anemometer located on top of the building near the main exhaust stack and telemetered to chart recorders located within the building. The wind-direction trace indicates the direction of the prevailing wind as well as the relation of temperature to altitude, that is, whether a large lapse rate, a normal lapse rate, or an inversion is occurring. These two parameters roughly define the sector in which sampling will take place. Consideration of the wind speed will more or less determine the optimum distance to proceed from the plant.

Sampling is conducted whenever precipitation does not occur and operability of the equipment permits. The monitoring interval is 1 hour at each location with approximately three sets of downwind samples taken each day. Also, on each sampling day a set of upwind background measurements is obtained for comparative purposes. During each sampling interval, three electrostatic precipitators are operated simultaneously in order to collect air samples for alpha activity. Beta-gamma activity is collected on air samples by filtering the air through Whatman No. 41 filter paper.

The alpha air samples are held for 5 days and then analyzed by counting the samples in low background proportional counters. Beta-gamma air samples are counted both 1 and 5 days after sampling. The data presented represent the measurement of the long-lived emitters.

The data obtained by the offsite monitoring program for alpha and beta-gamma airborne radioactivity are presented in table 1. Since

airborne radioactivity can arise from many sources, such as natural deposits in the earth, fallout from weapons tests, and discharges from atomic plants, the results obtained from the stack effluent air monitoring program are also presented in table 2.

TABLE 1.—OFFSITE AIRBORNE RADIOACTIVITY

[Average concentrations in $\mu\mu c/m^3$]

Period 1960	Upwind				Downwind			
	Alpha		Beta-gamma		Alpha		Beta-gamma	
	Number samples	Activity	Number samples	Activity	Number samples	Activity	Number samples	Activity
3d quarter	105	0.023	105	0.36	132	0.033	132	0.31
4th quarter	156	.023	104	.06	231	.016	154	.08
Annual summary	464	.023	319	.20	786	.024	531	.21

A comparison of upwind and downwind measurements of both long-lived alpha and beta-gamma airborne radioactivity indicates that there are no significant differences between them.

As mentioned above, the offsite airborne monitoring program serves as a verification of the ANPD stack effluent air monitoring program. This program consists of the continuous monitoring of alpha and beta-gamma activity of air exhausted to the environs from laboratory areas where radioactive materials are handled. It should be noted that this air is passed through high efficiency filters prior to monitoring and subsequent release to the outside atmosphere.

During the third and fourth quarters, sampling was conducted in 26 and 27 stacks, respectively. Samples are collected on Whatman No. 41 filter paper under isokinetic conditions. For the main exhaust stacks, filters are changed every 24 hours, or 72 hours for weekends. Samples from other stacks are generally changed weekly.

TABLE 2.—STACK EFFLUENT AIR MONITORING

[Average concentrations in $\mu\mu c/m^3$]

Period 1960	Main stack				Secondary stack			
	Number samples	Alpha	Number samples	Beta-gamma	Number samples	Alpha	Number samples	Beta-gamma
3d quarter	112	0.005	112	0.04	207	0.002	54	0.08
4th quarter	100	.002	100	.03	126	.001	36	.06
Calendar year	539	.006	539	.07	838	.001	284	.07

Comparison of average stack effluent air concentrations of alpha and beta-gamma radioactivity with the average downwind concentrations detected in the offsite monitoring program during similar periods of time indicates that the ANPD contributed negligible amounts of radioactivity to the atmosphere. In fact, even without consideration of the dilution that takes place with the atmosphere at the point of release, the effluent concentrations were notably less than the environmental levels both upwind and downwind.

Liquid Effluent Monitoring

Special consideration was given to the disposal of radioactive wastes when the ANPD facilities were designed. An elaborate drainage and retention tank system was designed to give positive assurance that radioactive wastes were not dumped into the local sewerage system. The waste from the laboratory areas flows into one of two sets of retention tanks. The contents of the filled tanks are sampled to determine radioactive concentrations. If the analytical results are below the prescribed control limit for safe disposal, the waste liquid is then passed through an acid neutralization pit before disposal into the sanitary sewerage system. If for any reason the analytical results are above the prescribed control level, the waste is then diluted until within the prescribed levels. Provisions have also been made for pumping wastes not meeting the control level into 55 gallon drums and burying them at a radioactive waste disposal site at Oak Ridge, Tenn. In the 8 years of operation, this method of disposal has not been found necessary.

Table 3 presents the average concentrations of enriched uranium in water passing through the liquid effluent system during the third and fourth quarters of 1960 as well as the 1960 annual summary.

TABLE 3.—RADIOACTIVITY IN LIQUID WASTES

Period 1960	Volume of liquid effluent (gallons)	Uranium ($\mu\mu c$/liter)
3d quarter	1,016,340	1,600
4th quarter	1,053,260	1,500
Calendar year	3,945,100	2,300

General Conclusions

The following conclusions are drawn from the data obtained in the environmental airborne and liquid effluent radioactivity monitoring programs during 1960:

1. The airborne activity in the environs of the ANPD is of a very low level and in accord with typical background levels of natural radioactivity, and

2. Operations at the ANPD contributed an insignificant amount of radioactivity in the liquid waste discharged to the city of Cincinnati sanitary sewerage systems.

Brookhaven National Laboratory

Associated Universities, Inc., Upton, N.Y., Issued December 1960 and March 1961

Environmental levels of radioactivity at the Brookhaven National Laboratory (BNL) have been reported in *Radiological Health Data*, volume I, No. 9 and volume II, No. 2. The following report summarizes the data for the third and fourth quarters of 1960 and the 1960 annual summary.

Laboratory operations affect the levels of natural background radiation in the vicinity of BNL in two ways: (1) by the discharge of coolant air from the graphite-research reactor, and (2) by discharging low levels of radioactive liquid wastes into a small stream.

As a check on the coolant air effluent, radiation levels are monitored at the boundary site. The values presented in table 1 do not include natural background, but represent the reactor's contribution from argon-41 produced in the coolant air.

The limit recommended by the National Committee on Radiation Protection and Measurements (NCRP) for radiation levels in the vicinity of a controlled area is 10 milliroentgens per week averaged over a period of 1 year. Thus, the highest level shown in table 1 for 1960, i.e., 0.72 mr/week, is far below the permissible level.

TABLE 1.—RADIATION LEVELS AT SITE BOUNDARY DUE TO LABORATORY OPERATIONS

[Average values in mr/week]

Period 1960	North gate (680 meters inside boundary)	Southwest perimeter	Southeast perimeter	Northeast perimeter
3d quarter	0.43	0.47	0.28	1.10
4th quarter	.25	.29	.55	.70
Calendar year	.40	.32	.48	.72

The average gross concentrations and total amount of radioactivity in BNL's liquid waste effluent where it leaves the site's boundary are shown in table 2. The liquid wastes produced by BNL operations contain a variety of radioactive substances at very low levels. These wastes are filtered, chlorinated, and released to a small stream that forms one of the headwaters of the Peconic River.

TABLE 2.—GROSS BETA ACTIVITY IN LIQUID WASTE EFFLUENT LEAVING THE BNL SITE

Period 1960	Effluent flow rate (gal/day)	Average concentration ($\mu\mu$c/liter)	Gross beta activity (millicuries)
3d quarter	369,000	300	38.9
4th quarter	302,000	380	39.5
Calendar year	495,000	185	126.6

Feed Materials Production Center

National Lead Co. of Ohio, Fernald, Ohio, Issued February 15, 1961

Environmental levels of radioactivity at the Feed Materials Production Center (FMPC) for 1959 and the first and second quarters of 1960 were reported in *Radiological Health Data*, volume II, No. 4. The following report presents a summary of the data for the third and fourth quarters and the annual summary for 1960.

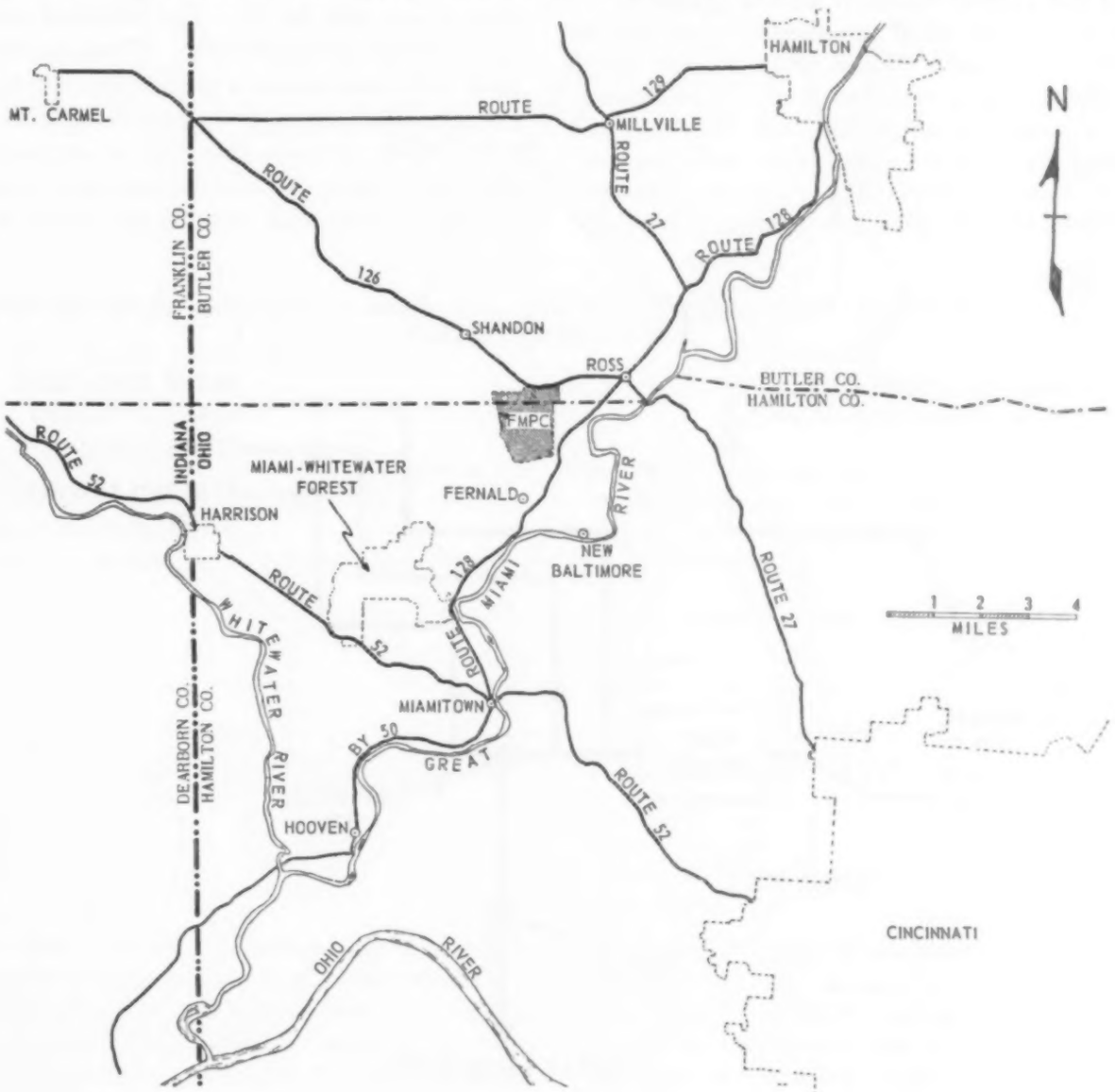
The Feed Materials Production Center is operated by the National Lead Co. of Ohio (NLO) for the Atomic Energy Commission. The project is located in a valley near Fernald in southwestern

Ohio. The production area of FMPC covers an area of 136 acres and is located approximately in the center of a 1,050 acre government-owned site. Most of the site, including the entire production area, is located within Hamilton County, Ohio, but approximately 200 acres are situated in southern Butler County. Adjacent to the site are the small villages of Fernald, New Baltimore, Ross, and Shandon, all being located 1 mile or more from the project. The larger nearby communities of Cincinnati and Hamilton are 20 and 10 air miles respectively (for relative locations see fig. 1).

Operations at this project deal with the processing of high-grade uranium ores and ore concentrates to produce metallic uranium. These processes include: acid digestion of the ores and concentrates, organic phase extraction of uranyl nitrate, subsequent conversion of the uranyl nitrate to uranium oxides and tetrafluorides, reduction to uranium metal, and fabrication of the metal into fuel elements. The project also includes plants for sampling ores and concentrates and recovering uranium from various residues. The final product is used in the United States as a fuel for nuclear reactors.

During the many involved reactions and processes that lead to the reactor fuels, various liquid and airborne wastes are generated which contain varying quantities of uranium. Various inplant methods are used to curtail their release into the environment surrounding the plant. Almost complete removal of the materials is accomplished

FIGURE 1.—AREA MAP OF RELATIVE LOCATIONS, FEED MATERIALS PRODUCTION CENTER



by using dust collectors and waste treatment processes. In order to determine the concentrations which reach the area surrounding the project, an environmental survey program has been established which consists of sampling water, soil, and air and performing analyses on the samples that are indicative of released material from the plant. The results of this program indicate that the control of material released to the environs at this site is well within the maximum permissible concentrations (MPC) as recommended by the National Committee on Radiation Protection and Measurements and as adopted by the State of Ohio.

Water Monitoring

Water samples are taken to determine the effect of the site's liquid wastes upon the Great Miami River into which all of the plant's liquid effluent passes. The results of the monitoring of liquid effluent have been reported to the Ohio Department of Health on a monthly basis since 1954 and duplicate samples are taken by a State engineer and a National Lead Co. of Ohio industrial hygienist. One sample every month is exchanged in order that each group can evaluate the other's sampling procedure and analytical results.

Each of the individual production buildings have collection sumps and treatment equipment to remove the uranium from the process waste water. The effluent from the sumps are collected at a central point for equalization. The water passes to a chemical waste pit (see fig. 2), which serves as a settling basin for removal of any remaining settleable solids from the water. The flow which is decanted to the clear-well portion of the pit is virtually free of solids and radioactivity. The effluent is then combined with three other types of project waste water and discharged to the river.

The locations of all water sampling points are shown in figure 3. A weir-type water sampler collects (at point B) samples of the combined stream (see also fig. 2). The collected sample is removed and analyzed daily. These results when used with measurements of river flow are the basis for calculated outfall river concentrations. Since it is difficult to have this type of sampler in an upstream (point A) and downstream (point C) location, weekly spot samples are taken at these

FIGURE 2.—FLOW DIAGRAM OF CHEMICAL WASTE AND DISPOSAL PROCESS, FEED MATERIALS PRODUCTION CENTER

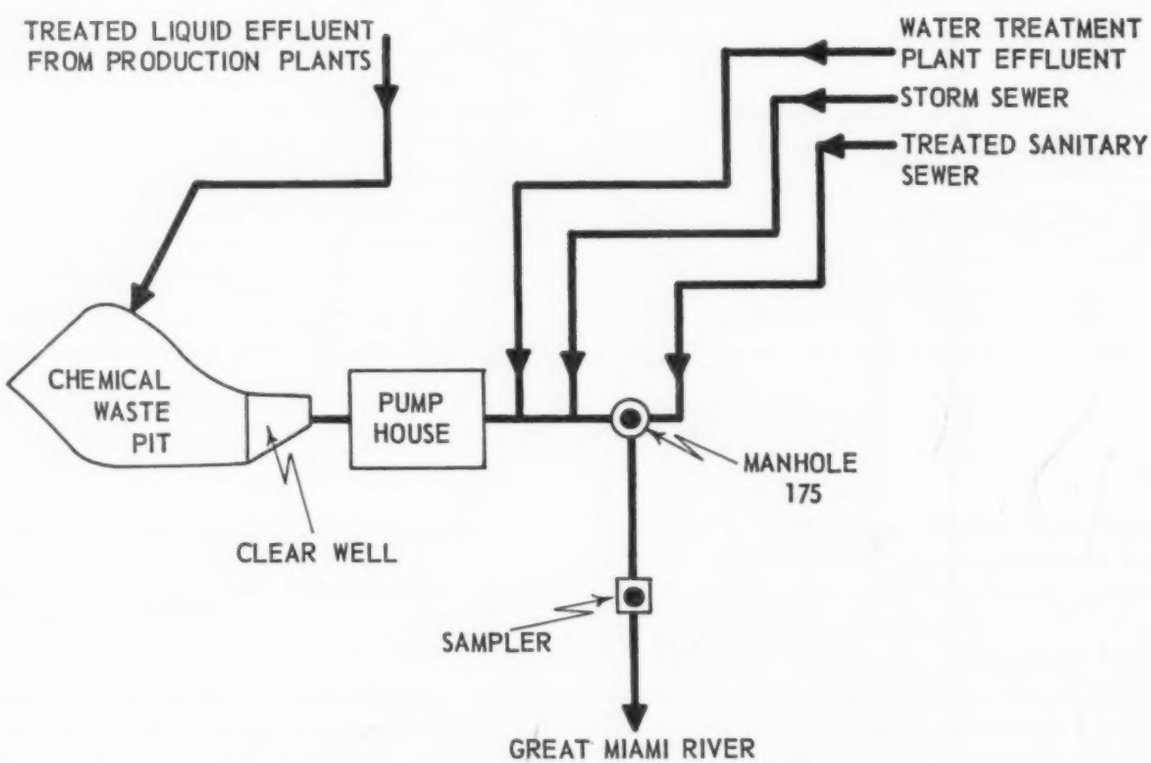
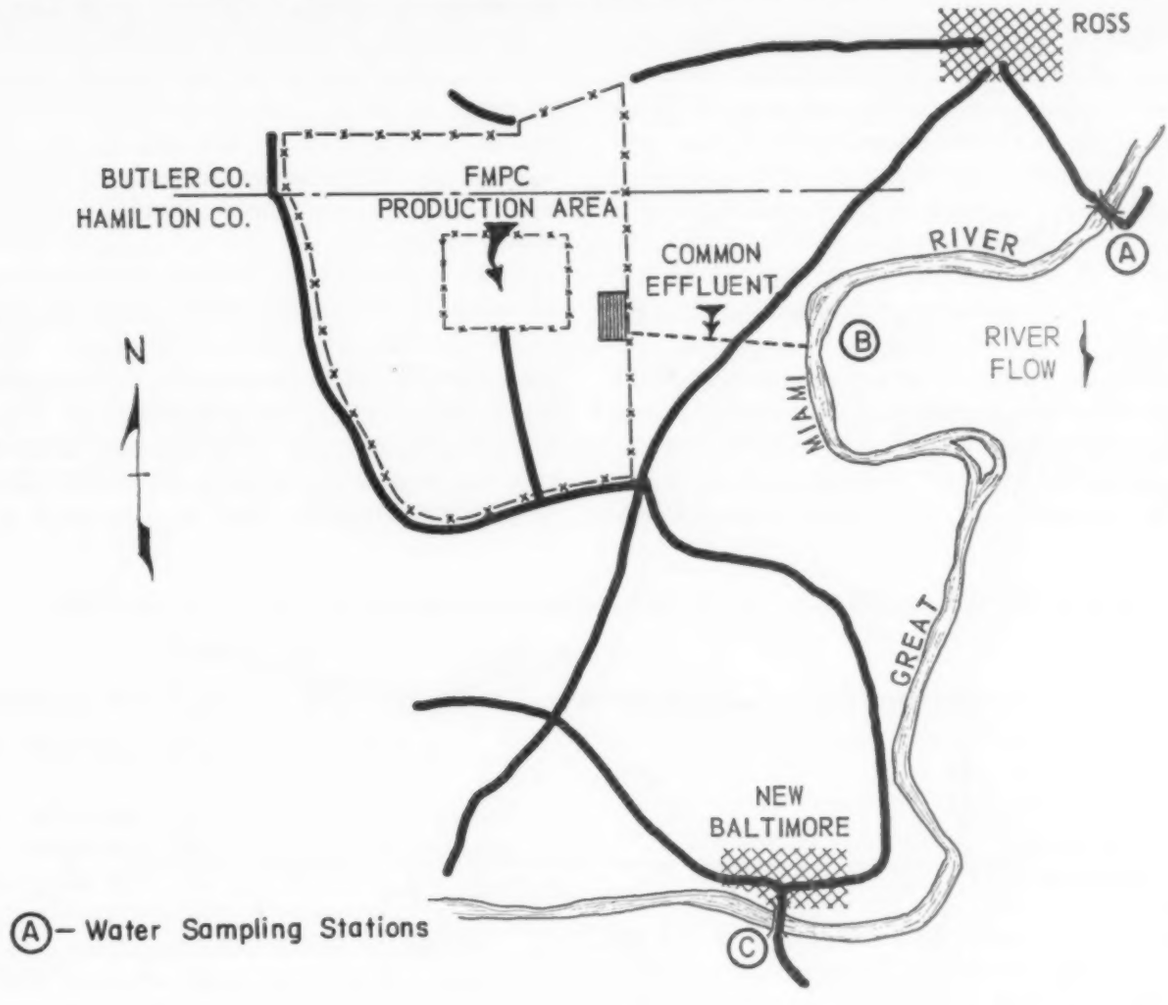


FIGURE 3.—WATER SAMPLING LOCATIONS, FEED MATERIALS PRODUCTION CENTER



points. The collected samples at all points are analyzed for uranium, total activity, chlorides, fluorides, and nitrates.

Table 1 presents the average concentrations of the sampled contaminants during the third and fourth quarters of 1960. The applicable MPC's and the percent of each MPC are also indicated for comparison.

TABLE 1.—RADIOACTIVITY IN GREAT MIAMI RIVER, 1960

[Average concentrations in μμc/liter]

Location (see fig. 3)	3d quarter					4th quarter					Calendar year				
	Number samples	Uranium	Percent MPC	Total activity	Percent MPC	Number samples	Uranium	Percent MPC	Total activity	Percent MPC	Number samples	Uranium	Percent MPC	Total activity	Percent MPC
Upstream (A)	18	12	0.06	36	1.02	19	15	0.08	38	1.30	76	12	0.06	34	1.13
Outfall (B)	92	10	.05	11	.36	92	13	.07	18	.60	364	6	.03	9	.30
Downstream (C)	18	15	.08	41	1.36	19	21	.10	45	1.50	76	18	.09	41	1.36
C minus A		3		4			6		7			6		7	

The data in table 1 indicates that the average calculated concentrations (B) of radioactive liquid waste discharged to the river were 0.6 percent MPC or less. The difference between upstream and downstream concentration (C—A), essentially the same figure as (B) arrived at by river sampling, revealed that liquid discharges averaged 0.23 percent MPC or less. It may be concluded from the data that the FMPC effluent produced little change in the river's quality. The results for 1960 are of the same magnitude as they have been in past years.

Air Monitoring

Air samples, rainwater, and gummed film from fallout stations are collected around the 1,000-acre plant site and at points as far away as 10 miles. The sampling of airborne particulate matter provides a good indication of the amount of material released into the atmosphere by the project. The amount of particulates in the air is calculated by drawing a known quantity of air through a filter medium and subsequently analyzing that filter for material indicative of the operations.

During the many involved processes, various airborne dusts are generated. Appropriate types of dust collectors, such as bag collectors, electrostatic precipitators, and scrubbing towers are specially designed for each operation and are attached to stacks that would have emissions of significant quantities. Exhaust stack sampling is maintained on a continuous sampling schedule.

The determination of the actual amount of material which is in the air surrounding the project is accomplished by the use of air sampling equipment. The samples are analyzed for uranium and total activity. The air sampling stations are shown in figure 4.

Table 2 presents the average concentrations for air sampling during the third and fourth quarters of 1960 as well as an annual summary. The percentages of MPC's for the annual summary are listed for comparative purposes. As the data indicate, the average airborne concentrations of uranium and total activity for 1960 were well below their respective MPC's.

FIGURE 4.—AIR SAMPLING LOCATIONS, FEED MATERIALS PRODUCTION CENTER

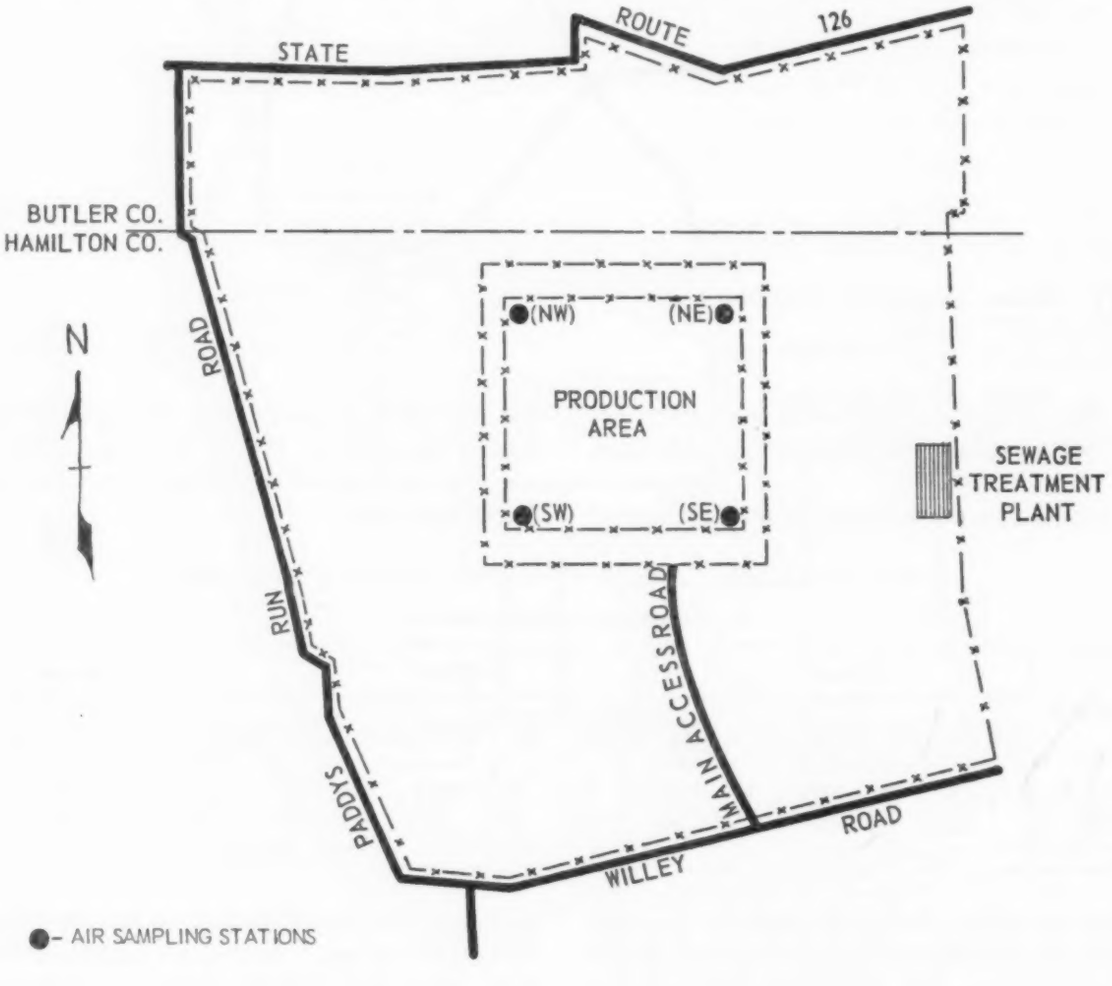


TABLE 2.—RADIOACTIVITY OF AIR FILTER SAMPLES, 1960

[Average concentrations in $\mu\mu$c/m^3]

Location	3d quarter			4th quarter			Calendar year				
	Number samples	Uranium	Total activity	Number samples	Uranium	Total activity	Number samples	Uranium	Percent MPC	Total activity	Percent MPC
Southwest	10	0.30	0.31	3	0.51	0.76	13	0.35	17.5	0.59	0.59
Northwest	12	.16	.15	8	.09	.15	30	.16	8.0	.28	.28
Northeast	11	.12	.12	10	.30	.45	31	.19	9.5	.33	.33
Southeast	10	.13	.12	9	.30	.38	19	.21	10.5	.30	.38
Plant average	----------	.17	.17	----------	.30	.44	----------	.23	11.4	.38	.30

Conclusion

During the third and fourth quarters, the concentration of airborne and water activity remained at low levels representative of the first half year. The results for the year are of the same magnitude as they have been in past years. These concentrations of materials present in air and water in the environs surrounding the FMPC project are well below their respective MPC's. Therefore, it may be concluded from this report that the Fernald area operations added insignificant amounts of radioactive materials to the surrounding environment.

Strontium-90 and Cesium-137 Body Burden Studies in Japan

The following tables present the results of assays conducted in Japan for strontium-90 in human bone and cesium-137 in various human tissues.

Data appearing in these tables were abstracted from AEC–tr–4245, entitled, "Annual Report of Scientific Research Grant for 1959 by the Ministry of Education (Government of Japan), No. 13, Radiation Cooperative Research," by Yoshio Hiyama, translated from *Nippon Gakujustu Shinkokai, 79,* 93 (1960).

Table 2 is based on data derived from assays of various bone, muscle, and organs from 13 cadavers (accident victims) during the period from August 1958 through April 1959. Analyses for cesium-137 were conducted on a total of 187 samples. The values listed in column 3 are the arithmetic averages for the number of samples assayed.

Since the number of samples was small and since quite large individual errors were observed, detailed studies could not be made. However, the general opinion that muscle contains large amounts of Cs^{137} was confirmed by this experiment, and it became clear that ribs also contain large amounts of Cs^{137}. The fluctuation of individual values was 0.091–0.95 $\mu\mu$c Cs^{137}/gm bone. If the arithmetical mean, 0.32 $\mu\mu$c Cs^{137}/gm bone, is compared with the data for Sr^{90}, it is clear that the concentration of Cs^{137} is 10 times as high as that of Sr^{90} in the human bone. (In this case, the author has compared the data in table 2 to a study conducted by J. L. Kulp at latitudes 20°–40° N during the period 1957–58. A value of 0.19 $\mu\mu$c Sr^{90}/gm Ca was obtained for that study. Assuming that calcium content is approximately ten percent of adult human bone, Kulp's value becomes 0.019 $\mu\mu$c Sr^{90}/gm bone.)

The beta ray energy of Sr^{90} (Y^{90}) is higher than that of Cs^{137}. Assuming the same distribution in bone for both species, it may be expected that the radiation dose in bone marrow attributed to cesium-137 is larger than that due to strontium-90. It is also known that cesium has a greater affinity for soft tissue. Therefore, it may be reasonable to assume that cesium is present in bone marrow in higher concentrations. If this assumption is correct, then the bone marrow dose due to cesium-137 becomes higher than that for strontium-90.

TABLE 1.—STRONTIUM-90 IN HUMAN BONES, OSAKA, JAPAN

Sex	Age	Time of death	Type of bone assayed	Cause of death	μμc Sr^{90}/gm Ca	Sex	Age	Time of death	Type of bone assayed	Cause of death	μμc Sr^{90}/gm Ca
1 male	0	2d quarter 1957.	Whole bones.	Stillbirth	0.04	2 male	0	2d quarter 1958.	Whole bones.	Stillbirth	0.07
Do	Fetus	2d quarter 1957	do	Abortion	.02	1 female	3 months	do	do	Pneumonia	.05
2 female	5 and 7 months					1 male	6	do	do	Congenital weakness.	.42
3 male	Fetus	3d quarter 1957	do	do	.35	Do	15 years	do	Femur	Suffocation	.08
	6 and 8 months					Do	18 years	do	Rib and tibia.	Cardio-plegia.	.47
2 male	Fetus	3d-4th quarters 1957	do	do	.41	2 female	0	do	Whole bones.	Stillbirth	.56
2 female	6 and 8 months.					1 female	5 years	do	Femur	Enteritis	.75
1 female	3 months	1st quarter 1958.	do	Meningitis	.28	Do	7 months	do	Whole bones.	Pneumonia	1.11
1 male	0	do	do	Stillbirth	.02	1 male	11 years	do	Femur	Heart asthma.	.30
Do	57 years	do	Chokan-kotsu [1] (a type of bone) rib and tibia.	Chronic alcoholic toxicosis.	.23	1 female	15 years	do	do	Heart marasmus.	1.47
						Do	2 years	3d quarter 1958.	Whole bones.	do	.25
1 female	57 years	do	Rib and Chokan-kotsu [1]	Liver cancer.	.12	1 male	13 years	do	Femur	Leukemia	.75
						Do	7 years	do	do	Pneumonia	1.29
1 male	13 years	2d quarter 1958.	Femur	Bankotsu-zuiro [1] (a bone disease).	.51	2 female, 1 male.	0	4th quarter 1958.	Whole bones.	Premature	.12
						1 female	3 years	do	Chokan-kotsu [1] and rib.	Basal fracture of skull.	1.04
3 female	0	do	Whole bones.	Weak vitality.	.13	1 male	9months	do	Whole bones.	Dyspepsia	.17
1 female	3 months	do	do	Pyrolus atrophy.	.83	1 female	7 years	do	Femur	Acute pnemonia.	.93
1 male	17 years	do	Femur	Acute pneumonia.	.27	1 male	1 year	do	Whole bones.	Heart	.82
Do	11 years	do	Whole bones.	Cancerous peritonitis.	.28						

[1] Transliteration.

TABLE 2.—CESIUM-137 CONCENTRATIONS IN HUMAN BODY ORGANS, OSAKA, JAPAN

August 1958–April 1959

Organ	Number of samples	μμc Cs^{137}/gm body tissue
Muscle	12	0.312
Ribs	13	.321
Stomach	11	.102
Large intestine	10	.0511
Liver	12	.154
Brain	12	.171
Lung	13	.201
Kidney	12	.162
Heart	13	.184
Spleen	12	.103
Bladder	12	.172
Pancreas	11	.156
Testicle	5	.133
Womb	1	.0522
Thyroid gland	1	.198
Artery	8	.120

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$\mu\mu c$ Sr^{90}/gm Ca
0.07
.05
.42
.08
.47
.56
.75
1.11
.30
1.47
.25
.75
1.29
.12
1.04
.17
.93
.82

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